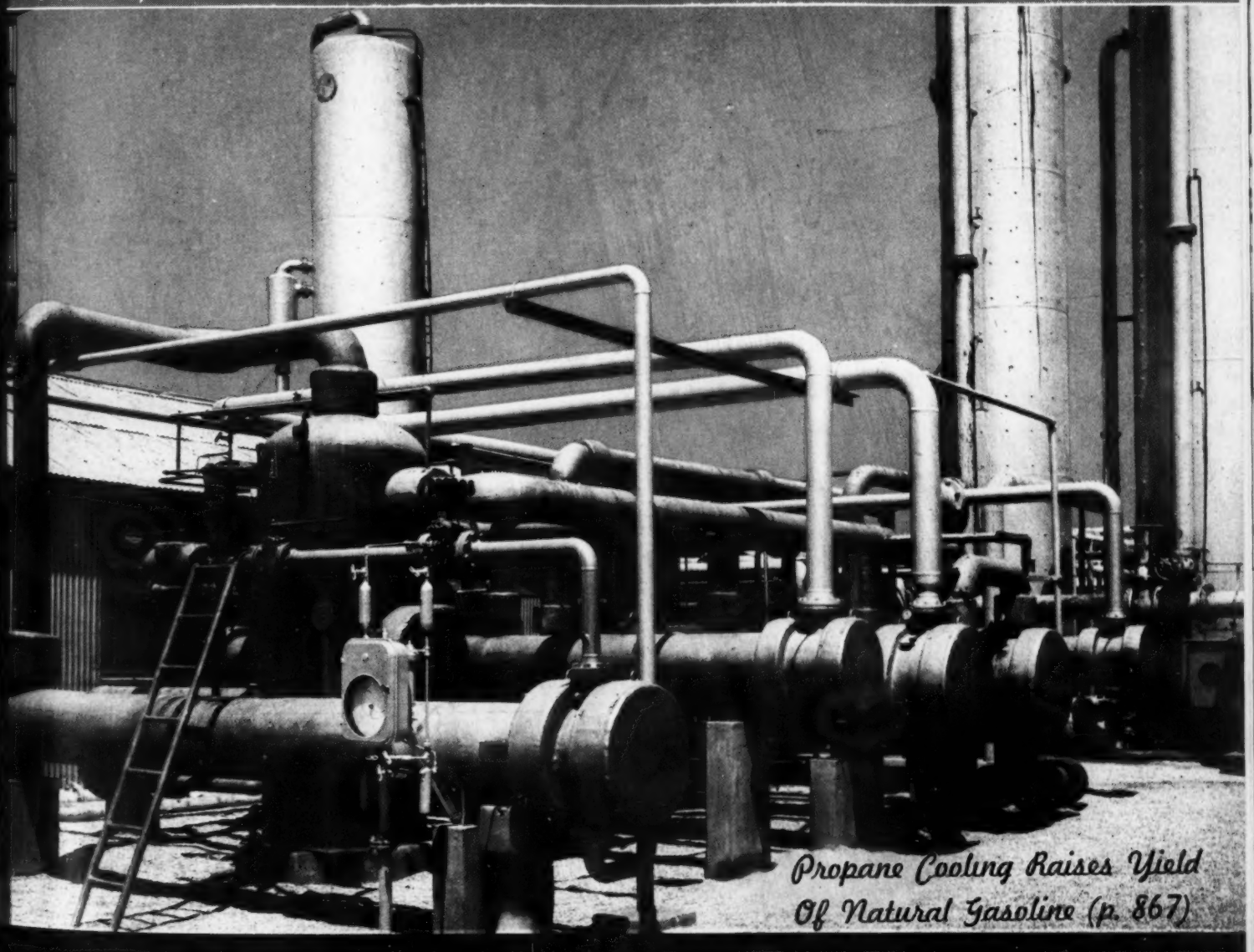
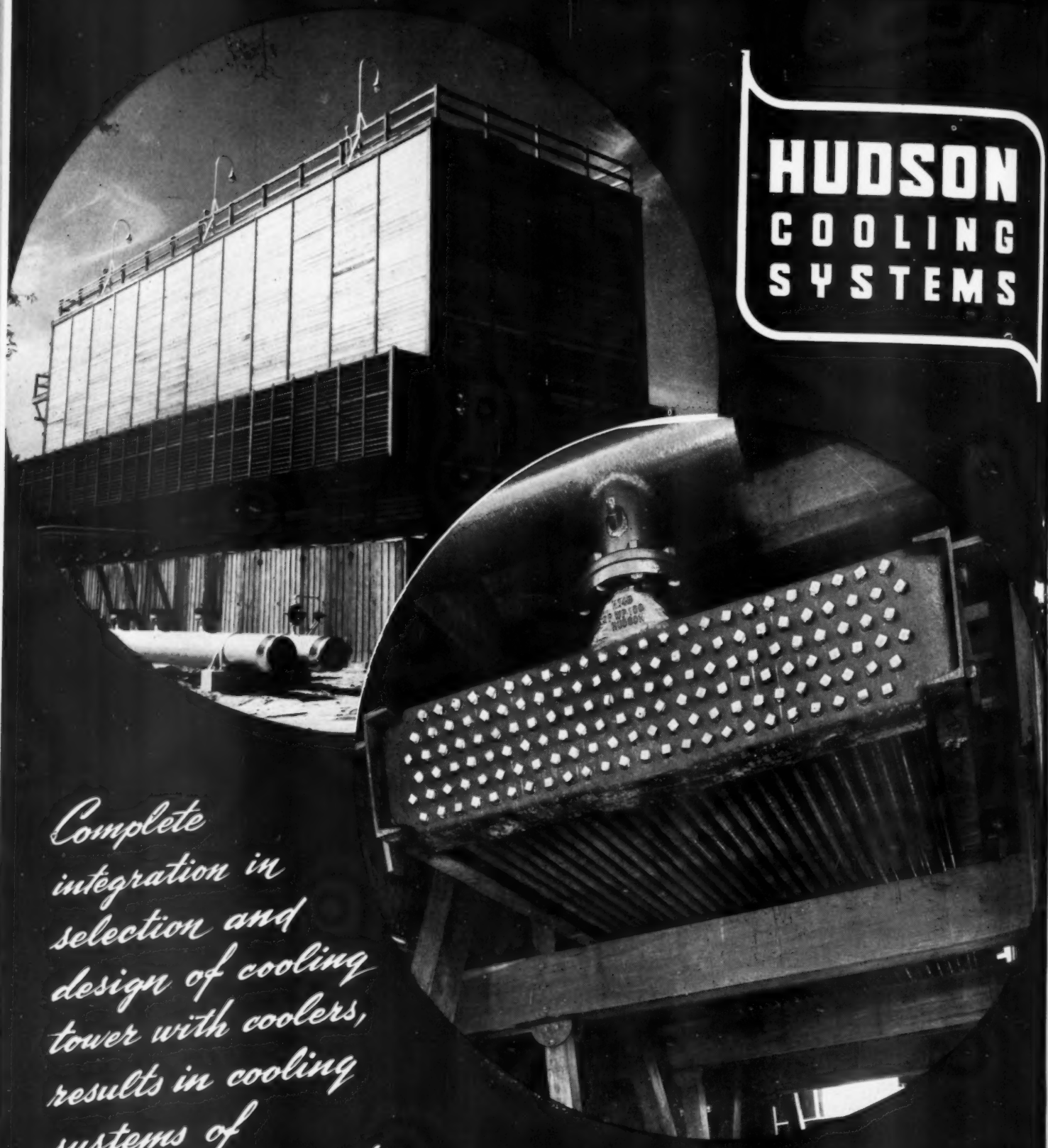
PETROLEUM PROCESSING

VOLUME 3, NUMBER 9 SEPTEMBER, 1948



Propane Cooling Raises Yield Of Natural Gasoline (p. 867)

FORMERLY MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS



HUDSON COOLING SYSTEMS

Complete integration in selection and design of cooling tower with coolers, results in cooling systems of minimum first cost and minimum operating cost.... and the responsibility is undivided.....

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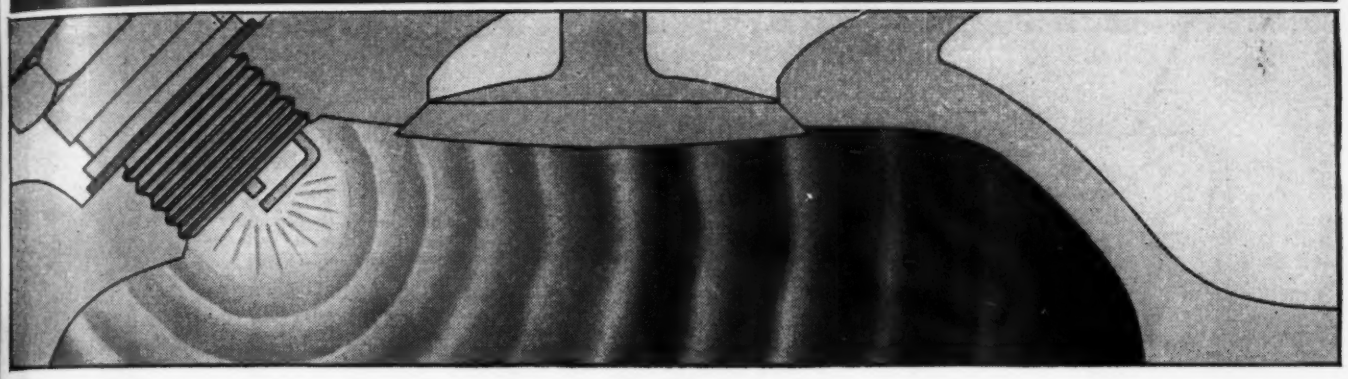
THE ETHYL CORPORATION SERVES THE PROGRESSIVE PETROLEUM INDUSTRY *Through Research*



What goes on inside a combustion chamber?

TWO FACTORS have combined to keep science in the dark on the vital problem of combustion—and how it relates to the hydrocarbon structure of fuels.

(1) The entire combustion cycle—compression, ignition, flame travel and power stroke—may take place in only 1/60 of a second and often encompasses action at supersonic speed that well-nigh defies photographing!

(2) All hydrocarbons burn to practically identical end-products—water and carbon oxides—so that we cannot determine much about combustion from an examination of engine exhaust gas.

Notwithstanding these obstacles, combustion research by manufacturers of engines and by suppliers of fuels and additives has never slackened. More knowledge is essential if the advance in fuel and engines is to continue and maximum energy is to be realized from each gallon of precious gasoline.

In the Ethyl Research Laboratories, many avenues have been explored. When full-scale engine studies proved impracticable, special single-cylinder engines with unusual instruments were developed for better control and observation. Engines of high volumetric efficiency for attaining up to 760 IMEP and high compression ratio (17.5 to 1), and equipment for delicate measurement of heat flow and for exact determination of preignition, wild ping and knock, were developed by Ethyl research engineers.

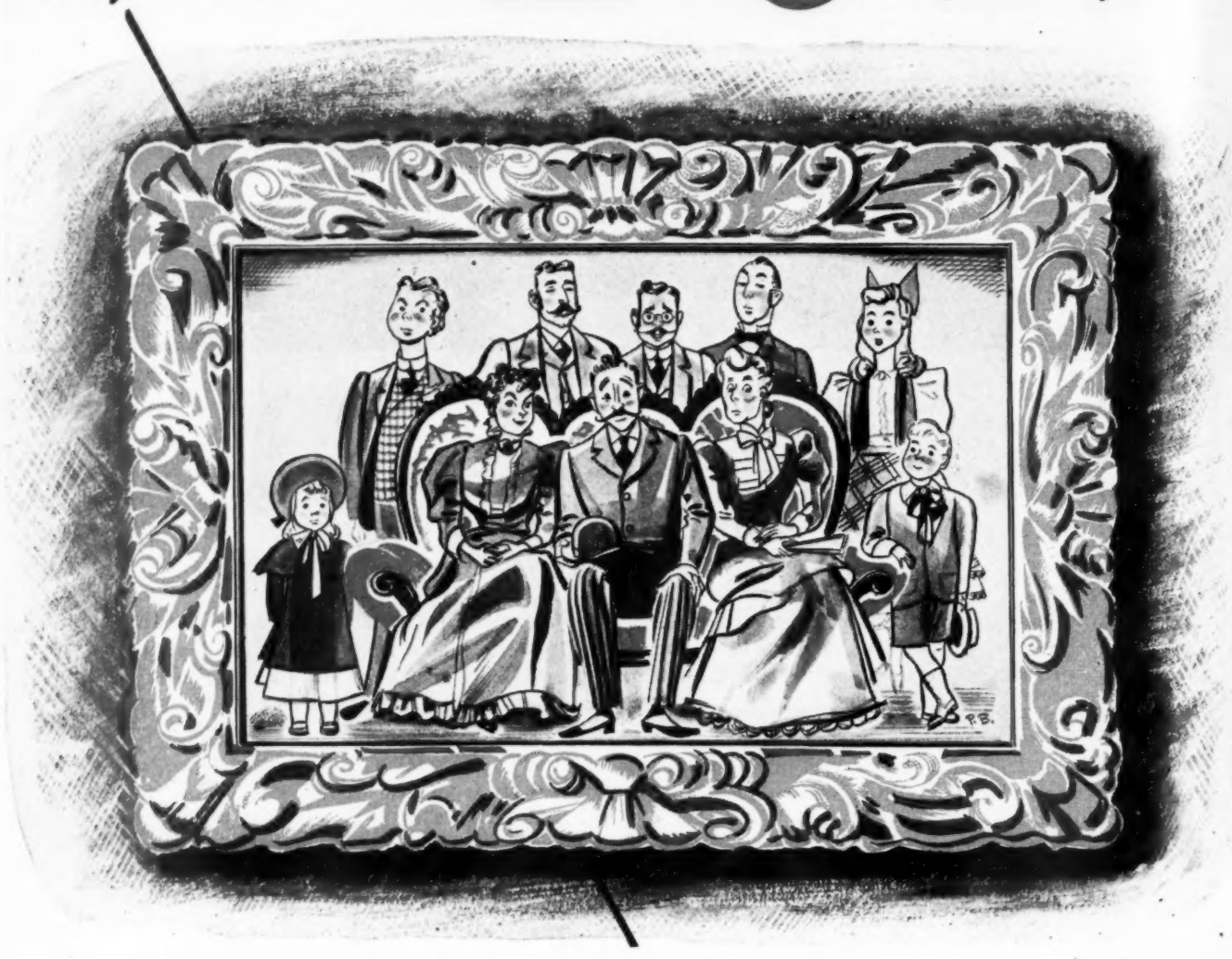
But Ethyl's work has not been confined to engines. Pioneer study in slow oxidation and spontaneous ignition proved that events ahead of the flame are responsible for the phenomenon of knock, and helped to explain the difference in knocking tendency between different hydrocarbons and the mechanism by which tetraethyllead stops knock. Still looking forward, Ethyl now is investigating ignition, flame propagation and combustion products of fuels and additives in a variety of burners, from small glass tubes to jet engine combustors.

All this work has been directed toward relating the hydrocarbon structure of fuels and the effects of fuel additives—not only to knock but also to other aspects of fuel performance, such as ease of ignition and cleanliness of burning.

Basic research on combustion is carried on by the Research Laboratories of the Ethyl Corporation as a part of a never-ending program to improve the composition and usefulness of "Ethyl" brand of antiknock compound, and as a service to oil companies in the development of better petroleum products capable of economical production.

ETHYL CORPORATION
RESEARCH LABORATORIES
1600 West Eight Mile Road, Detroit, Michigan
2600 Cajon Road, San Bernardino, California

Do you know the *whole* POROCEL "family"?



It's a *large* "family" of high-grade activated bauxites—well worth knowing if you're looking for:

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2. A rugged carrier having adsorptive properties for use as a catalyst support.
3. A high-surface-area catalyst for desulfurization and reforming systems.
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VOLUME 3
NUMBER 9
SEPTEMBER, 1948
PUBLISHED
MONTHLY

PETROLEUM PROCESSING

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OILGRAM NEWS
OILGRAM PRICES
PLATTS'S OIL PRICE HANDBOOK

Covering the Management, Design, Operation, Equipment, Products of Plants Processing Crude Oil and Natural Gas into Fuels, Lubricants, Chemicals

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★ **Indicates Exclusive in PETROLEUM PROCESSING**

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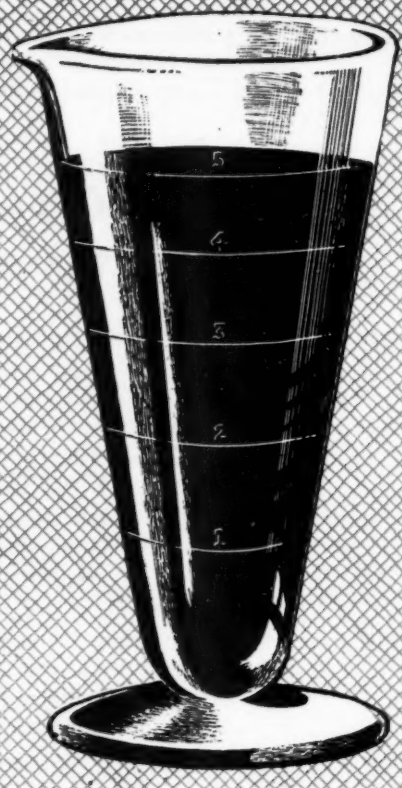

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the formula for progressive refining?

It's not a matter of chemical symbols, and the proportions are certain to vary according to the job that's to be done. But the basic elements are the same wherever efficiency and economy must be combined in progressive refining.

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What's Happening!

SEPTEMBER 1
1948

Important Current News Summarized for Refiners

EXPANSION

Continental Oil Co. has started construction at its Ponca City, Okla., refinery on an expansion program which will increase capacity to 52,500 b/d—and make the refinery the largest in the state. Present capacity is 33,500 b/d. Major part of program will be installation of new 30,000 b/d crude topping unit, in addition to repair and modernization of TCC unit recently acquired from the government.

Shell Oil's plans for a refinery at Woodbridge, N. J., continue to pop up—although still lacking any confirmation from the company. Latest development was the company's bid of $270,000 for the purchase of 300 acres of township-owned land in an area which was recently rezoned to permit building a refinery there.

Tide Water Associated Oil Co. will install a new TCC unit at its Drumright, Okla., refinery, with Process Engineers, Inc., Dallas, as contractor. Unit is designed to charge 4500 b/d of either Oklahoma gas oil or high sulfur West Texas gas oil. Licensor is Houdry Process Corp., Philadelphia.

Warren Petroleum Corp. has started construction of four LP-gas terminals as part of a program "to conserve seasonal excess production for ready distribution in periods when current output is inadequate to meet peak demand." Seasonal fluctuations in demand are one of the biggest headaches in LP-gas. The four terminals will have a total of 160 high pressure tanks of 30,000 gal. capacity each, and are being built at Mobile, Ala.; Little Rock, Ark.; Des Moines, Iowa; and Cedar Rapids, Iowa.

• • •

REFINERY OPERATIONS

Crude runs to stills tapered off during August from the record of 5,791,000 b/d set during week ending July 10. Low point was hit in week ending August 14, with 5,535,000 b/d.

Crude production, on the other hand, set three new records in a row for the first three weeks of the month, getting up to 5,521,300 b/d for the week ending August 21. Previous record was 5,493,900 b/d, during June.

Refining capacity may be the bottleneck during the next 12 months if demand continues to increase, according to Robert E. Wilson of Indiana Standard, chairman of NPC's committee on Petroleum Refining Capacity. In a preliminary progress report, the committee estimated that domestic refining capacity by the end of this year would be 5,919,000 b/d, but warned that "It is quite apparent that the expansion of refinery throughput which has recently set new high records almost every month must flatten off from now on."

• • •

MARKETS, PRICES

Refined products prices tended downward in August as stocks of all principal items, except gasoline, continued to mount. Even with gasoline, supplies at the primary level were sufficient to occasion widespread relaxation of allocations to wholesalers and retailers.

Outstanding development price-wise was a 20c decline to $2.20 per bbl. in low quotations reported for No. 6 Fuel from Group 3, and Bunker "C" was available in cargo lots at the Gulf at $2.46 per bbl. as compared with around $3.00 late in July . Wax prices also were off—0.5c per lb. in domestic trades, 1c per lb. for export.

For other products, declines were mainly on the highs of price ranges. Prices at the lows of ranges, however, were being offered to all comers in many instances; in recent months material had been available at the lows to regular customers only.

Price of metallic lead went up July 28 from 17.5c per lb. to 19.5c, the third price jump this year. It wasn't long before tetraethyl lead followed along. On Aug. 10 Ethyl Corp. announced that effective Oct. 16 the new prices for TEL would be 59.1c per lb. for motor mix, 64.6c for aviation mix (present Ethyl prices are 54.98c and 60.478c per lb., respectively).

As expected, DuPont followed shortly with its own price increase, effective Oct. 1—about 36.3c per lb. for motor mix and 39.7c for aviation mix (present prices are about 33.8c and 37.2c per lb., respectively).

• • •

PETROCHEMICALS

Shell Chemical Corp.'s multi-million dollar expansion program at Houston hit the gong four times last month. During a period of less than two weeks the company announced that (1) its new plant for the manufacture of methyl ethyl ketone and secondary butyl alcohol is on stream, (2) its synthetic ethanol plant is expected "to begin operation soon,"

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

(3) delivery in large-scale quantities of ethyl chloride is scheduled to begin about the end of September, and (4) its commercial synthetic glycerine plant, the first such installation in the world, will begin operation by late summer or early fall.

• • •

SYNTHESIS

Stanolind has dropped its plans to build a synthesis plant near Garden City, Kans., because of increased costs, according to President E. F. Bullard. Reinstatement of a similar program in about three years is under consideration. Cost of the project, which would have produced about 7500 b/d of liquid products from natural gas, had been estimated at $80 million.

Carthage Hydrocol immediately announced that it was "proceeding with all possible speed" to complete its similar project, already under construction at Brownsville, Texas. Carthage Hydrocol hopes to complete its plant early next year.

India is interested in establishing a synthetic fuels industry utilizing second and third grade qualities of coal, according to a report from the India Society of Engineers. A committee has been established to work out details in consultation with "foreign experts," and arrangements have already been made for the testing in this country of the suitability of Indian coals.

• • •

PRODUCTS

Diesel oil thickened with aluminum soap to a jelly-like consistency is now being marketed by Esso Standard as an aid in firing stoker-fed industrial boilers. The thickened fuel in stoker-fed furnaces has been found to fire boilers in 30 minutes as compared with eight hours with coal and wood kindling. The product is a result of wartime developments of fuel for flame throwers and incendiary bombs.

Octane ratings averaged higher last winter than in the previous one, the Bureau of Mines reports, with the national average for regular grades standing at 75.3 and that for premium grades at 79.4. In winter of 1946-47, average octane count of regular was 75; of premium, 78.5. Survey covered service station gasolines of 140 major and Independent companies.

Rust preventative compounds will be manufactured by Lion Oil in a new $250,000 plant the company is now building adjacent to its 20,000 b/d refinery at El Dorado, Ark. The plant is expected to be completed in December, and will manufacture solvent type, oil type and grease type rust preventatives, as well as a line of mastic type coatings.

Lime soap greases will be manufactured by a continuous process in a new plant which Esso Standard is building at its Baltimore refinery. The plant, first of its kind, is expected to be in production early this fall.

A new Diesel engine lubricant has been developed by California Standard, called "RPM Delo supercharged lubricating oil." The company is now completing marketing plans for the product, which is reported to be useful for "extending the period between engine overhauls which have been undesirably short in certain areas where high sulfur fuels are used here and abroad, and under certain conditions of extremely severe operation."

• • •

RESEARCH

Sinclair Refining has completed its new research and development laboratories on a 38-acre site at Harvey, Ill. Research facilities are being moved there from previous quarters at Sinclair's East Chicago refinery.

Stanolind Oil & Gas Co. will begin construction this fall of a new and larger research center at Tulsa. A 60-acre site has been purchased for the center, which is expected to be ready for use early in 1949.

Socony-Vacuum has doubled its program of fellowships in chemistry and physics in recognition of the need for still greater acceleration of the training of scientists. In addition to 10 fellowships established last year and which are being continued, at least 10 more will be established for the 1949-50 academic year.

• • •

MISCELLANY

Union Oil's Hypersorption process is meeting with enthusiastic industry acceptance, according to the company. It is now revealed that a total of three units have been licensed—Dow Chemical Co., Rohm & Haas, and Lone Star Gas Co., with other licenses pending. In addition, Union is now designing its own large commercial unit for the production of ethylene.

• • •

TRANSITION

The Texas Co. will close its 27,500 b/d refinery at Galena Park (Houston), Texas, approximately Oct. 1.

Max W. Ball has agreed to continue as director of Interior's Oil and Gas Division through October meeting of National Petroleum Council—but with firm understanding that that, for him, will be the end.

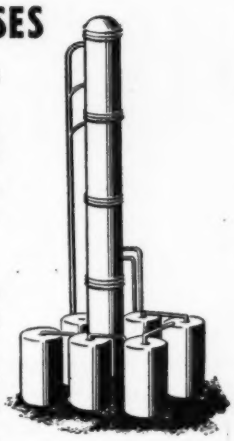
Announcing

SWIFT'S FATS and FATTY ACIDS

for technical uses

Swift & Company is now inviting inquiries on its new lines of fatty acids and fractionated glycerides. Extensive use of solvent processes will make possible new high standards of purity and stability.

1 THE PROCESSES



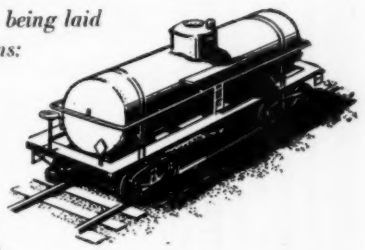
Solvent processes yield fat fractions of higher quality and wider usefulness. Most of Swift's new fats and fatty acids will be processed with solvents.

Unsaturated acids and drying oils will be separated by the Solexol process, using propane as a solvent. Fractions are separated selectively at temperatures not exceeding 200 degrees F. Since thermal and chemical side reactions are thereby avoided, products of greater purity and stability are obtained.

Saturated acids will be fractionated by solvent crystallization. Here, too, processing temperatures are low and harsh catalysts are absent, so that the natural structure of the substances is preserved.

2 THE PRODUCTS

Production plans are being laid for the following items:



Swift's Mixed Fatty Acids
Swift's Cottonseed Fatty Acids
Swift's Animal Fatty Acids
Swift's Linseed Fatty Acids
Swift's Corn Oil Fatty Acids
Swift's Soybean Oil Fatty Acids
Swift's Palm Oil Fatty Acids
Swift's Hydrogenated Marine Oil Fatty Acids

Swift's Fractionated Fatty Acids
Swift's Stearic Acid
Swift's Oleic Acid

Swift's Drying Oils
Swift's Fractionated Sardine Oil
Swift's Fractionated Menhaden Oil
Swift's Fractionated Soybean Oil
Swift's Fractionated Linseed Oil

Other Swift Glycerides
(*now in production*)
Swift's Lard Oils
Swift's Tallow Oil
Swift's Marine Oils
Swift's Neatsfoot Oil
Swift's Sperm Oil

Specialties
(*now in production*)
Swift's Sulfonated Sperm Oil
Swift's Sulfonated Tallow Oil
Swift's Sulfonated Castor Oil (Turkey Red Oil)
Swift's Sulfonated Neatsfoot Oil
Swift's Spermaceti
Swift's Textile Oils
Swift's Anti-foam Agents

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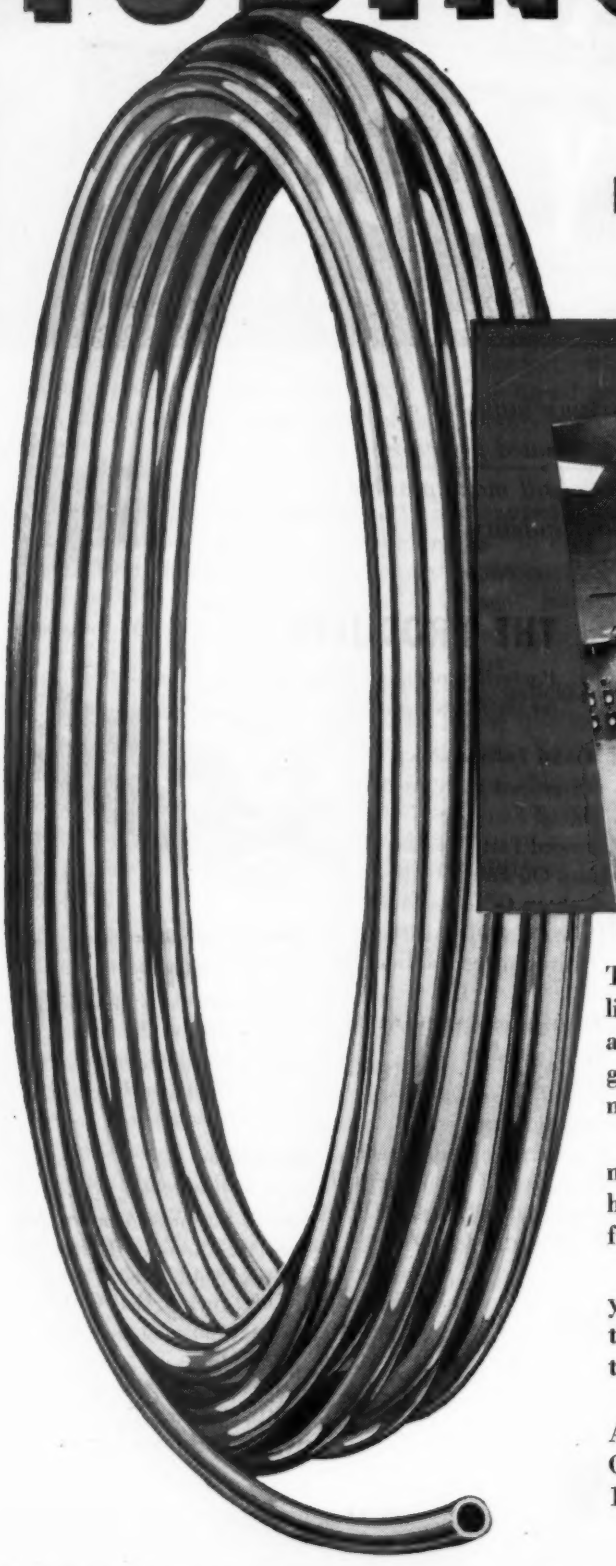
TUBING VALUE

FOR INSTRUMENT LINES



Today's best buy for pneumatic and hydraulic instrument lines is Alcoa Aluminum Tubing. It costs less per foot than any other easy-to-form, small-diameter tubing. You can get it promptly in standard diameters and wall thicknesses from your nearby Alcoa Distributor's warehouse.

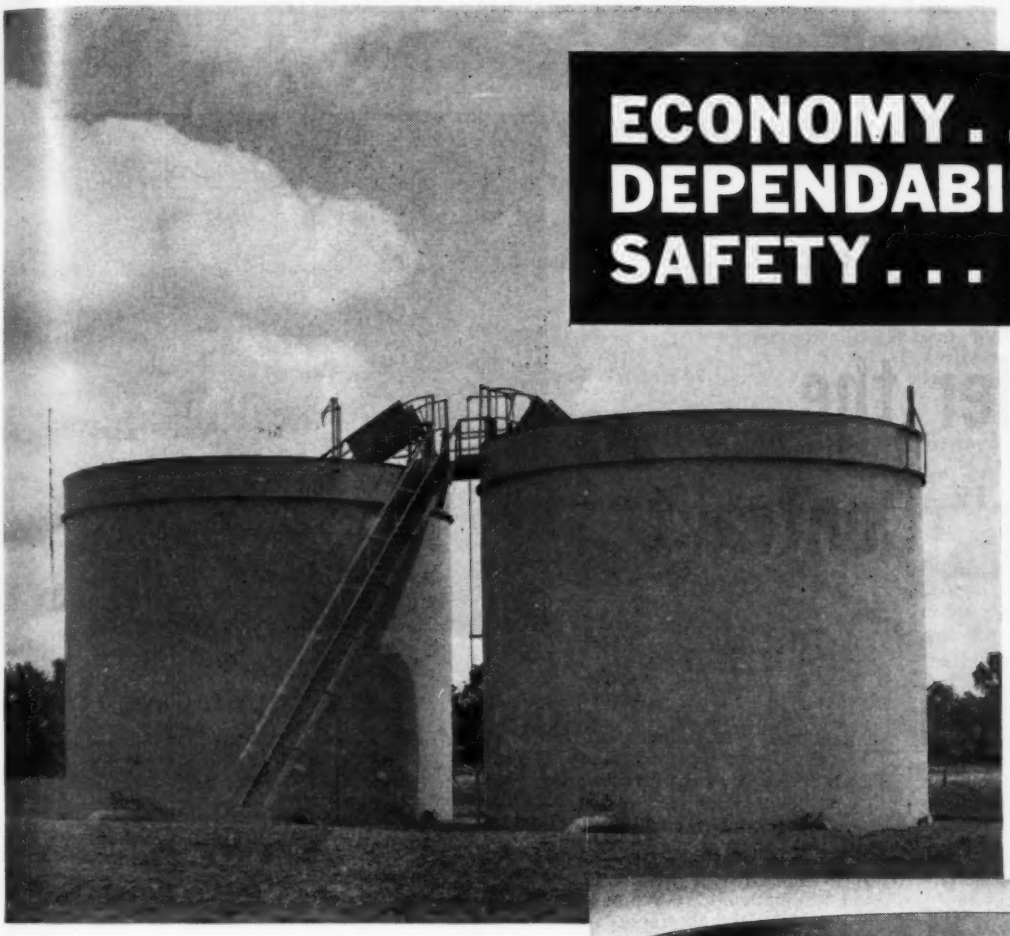
You'll like the ease of bending and flaring Alcoa Aluminum Tubing. It's light, but strong and pressure-tight. It has high resistance to corrosion by moisture, H_2S, ammonia fumes, and refinery atmospheres.

Take advantage of the characteristics of aluminum in your operations by using it wherever possible. You will find that the use of aluminum fittings will contribute greatly toward the over-all performance of your tubing systems.

Ask your nearby Alcoa Distributor to supply you with Alcoa Aluminum Tubing. Or call your local Alcoa Sales Office. ALUMINUM COMPANY OF AMERICA, 1784 Gulf Building, Pittsburgh 19, Pa.

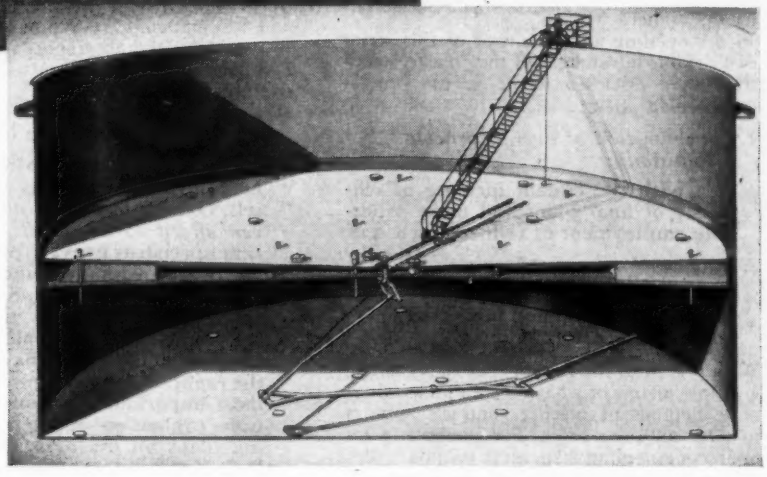
ALCOA ALUMINUM

ALCOA *Aluminum* TUBING



ECONOMY... DEPENDABILITY... SAFETY...

The view at the left shows two 5,000-bbl. tanks with Horton Double - Deck Floating Roofs at the California Company's plant at Lake St. John, La. Below is a cutaway view of a flat-bottom tank showing the construction details of the Horton Floating Roof.



THE HORTON Double Deck FLOATING ROOF

ECONOMY, dependability and safety—three words that describe the Horton Double-Deck Floating Roof, and three words which represent the indispensable qualities of a storage tank used to handle volatile petroleum products.

When installed on flat-bottom tanks storing volatile liquids that do not boil at normal temperature, the Horton Floating Roof stops all evaporation losses due to filling, and practically all standing storage losses—it has the most efficient seal ever used on a floating roof. At the same time that it prevents evaporation losses, the seal greatly reduces the danger of fire, since it does not allow a combustible mixture to form above the roof. Another way in which the floating roof reduces fire hazard is by floating directly on the liquid surface thus eliminating any vapor space where fire might occur inside the tank.

Get complete details on the Horton Double-Deck Floating Roof. Write our nearest office for a copy of Bulletin B.

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Chicago, 4 .....2114 McCormick Bldg.
Cleveland, 15 .....2215 Guildhall Bldg.
Detroit, 26 .....1532 Lafayette Bldg.
Havana .....402 Abreu Bldg.
Houston, 2 .....2130 National Standard Bldg.
Los Angeles, 14.....1426 Wm. Fox Bldg.
New York, 6.....3310-165 Broadway Bldg.
Philadelphia, 3....1630-1700 Walnut Street Bldg.
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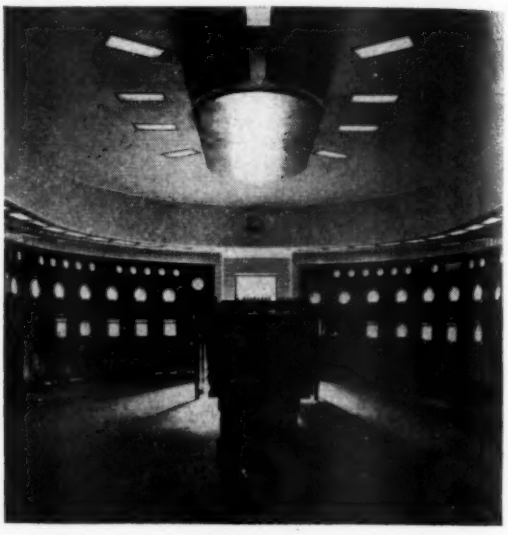
No. 2 in a series

Process engineering under the "Master" Contract



THE basic step in all refinery expansion or modernization is, of course, process engineering. And it is in this first step that the so-called "master" type of contract—under which one engineering company takes complete responsibility for all work at any particular job site—starts paying dividends to any refiner.

In the opening advertisement of this series two definite advantages of the "master" contract were disclosed to lie in the process engineering phase:

1. *Concentration of overall process responsibility*

   . . . with consequent increase of efficiency of final plant and more profitable employment of refiner's own staff

2. *Integrated process planning*

   . . . providing actual initial capital savings and continued improved operation efficiency

With regard to the first of these advantages, a simple review of what goes on under alternate methods of placing contracts appears to offer sufficient proof. For example, a refiner's engineering staff must originally decide on the general plan for any expansion or modernization—based on its own intimate knowledge of the company's current situation and its future marketing plans.

To do this, even the largest companies customarily call in outside engineering counsel. For, with very few exceptions, refiners cannot afford to maintain specialists in every refining step devoting themselves to a particular process on a full-time basis. Since the advisory engineers called in usually work for companies whose business is building refineries—and since they quite naturally desire their company to get the lion's share of the forthcoming order—a "promotion" of varying processes and methods usually ensues.

As a result, instead of being faced with the calm evaluation of engineering principles and the comparative economics of alternative processing plans, the refiner's staff becomes involved in refereeing the claims of rival engineering experts—arriving, all too often, at a processing sequence that represents a compromise of conflicting opinions.

By contrast, the "master" contract method of operation is simplicity itself. One engineering contractor—*who can afford to* and *does* employ full-time specialists in every phase of processing—provides the refiner's staff with as many alternate processing sequences as are desired. Each of these plans is fully integrated—with all engineering factors included and balanced. Thus the *refiner's* staff can concentrate on its most important function—the expeditious evaluation of alternate processing plans *on the basis of economics*, including product yields and qualities, operating costs, maintenance costs, marketing requirements and crude supply, both present and future.

by
LUTHER HILL
In Charge of Process Engineering

The second stated advantage is a natural outgrowth of the first. It is safe to say that just two of the many "plus" factors present under the "master" contract operation would justify its adoption—namely (1) the uniformity of processing tolerances in all units embraced in the overall plan and (2) the saving in engineering man-hours generally wasted under alternative methods in checking processing details between the refiner and several engineering contractors and vice versa.

The purchase of useless excess reserve capacity in one or more units of a series is automatically precluded while at the same time the ability to operate all units efficiently at maximum output levels is achieved. The saving in engineering man-hours is not only of actual dollars but more important, of *time*, which results in units going on stream earlier—with consequent increase in refiner's income.

There are, of course, many other advantages of integrated process planning by one company which can be discerned in the centralization of controls, the integration of heat balances and efficiencies, and the steps taken to insure continuity of processing.

But beyond these details, monetarily important as they are, is the overpowering logic that under the master-type contract, a refiner makes a more valuable tool of his engineering staff—for he automatically relieves it of engineering detail and allows it to concentrate on the all-important matter of making the most money for him.

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TOMORROW

. . . IN PETROLEUM TECHNOLOGY

Recent technological and economic developments discussed here in the light of their future bearing on petroleum refining operations include:

- ***Ammonia demand outstripping production rate.***
- ***Use of oxygen in gas synthesis is growing.***
- ***Specialty oil is heat transfer medium.***
- ***University patent policies are surveyed.***
- ***NAM reports on trends in industrial research.***

Ammonia Demand Still Outstrips Production

AMMONIA IS A CHEMICAL commodity in great demand in agriculture, industry, and warfare. In agriculture, it is used as a fertilizer in the form of ammonium salts, nitrate salts, ammoniated superphosphates, and urea—its direct use has lately found increasing favor.

In industry, particularly in chemical manufacturing, it is used as a neutralizing agent, in the nitriding of steel, in atomic hydrogen and oxyhydrogen arc welding, as a refrigerant, in the synthesis of such substances as dyes and nylon, in water purification, etc. "Almost all industrial and military explosives contain nitrogen."(1)

The ammonia synthesis industry was expanded greatly during the war and many of the plants which were built depend upon natural gas for their source of hydrogen. Since the war, the majority of these warbuilt plants have been sold or leased to private companies, which have concentrated their efforts on the production of nitrogen fertilizers, since the latter are in world-wide short supply. A number of plants, however, have converted at least part of their capacity to the synthesis of methanol.

Details of the disposal of several of the government plants have recently been described in a report(2) issued by the U. S. Department of Agriculture. At the time this report was prepared, four of the plants remained in government hands; since that time, however, one has been transferred to the Bureau of Mines for use in research on synthetic liquid fuels (the Missouri Ordnance Works), while another (The Cactus Ordnance Works, at Etter, Texas) has recently been leased on a long term basis to the Phillips Chemical Co.(3)

This subsidiary of Phillips Petroleum Co. was organized recently to conduct its chemical, synthetic rubber, and carbon black manufacturing operations. At Etter Phillips plans to spend $16,000,000 to double synthetic ammonia capacity (now approximately 70,000 tons per year) and to construct a new ammonium nitrate plant. The Army will have a five-year option to buy all or part of production from these plants, for whose continued operation Phillips has guaranteed a gas reserve of 200 billion cubic feet, enough to operate the plant for 20 years. Future plans are said to call for an ammonium sulfate plant, on the Houston ship channel, and other chemical plants.

The Lion Oil Co.(4) is spending $3,500,000 to increase from 430 to 570 tons per day the anhydrous ammonia capacity of the El Dorado, Ark., plant which it purchased from the government.

As pointed out by Stenerson(5) even though production of synthetic ammonia was 5.3% greater during the first four months of this year than it was in 1947, "ammonia demands in the aggregate have increased 10 to 15% or even more . . . due to expanded industrial and nitrogen fertilizer needs, especially for export." Various methods of partially overcoming the present shortage (said to exceed 500-630 tons of ammonia per day) are being employed, but even in the aggregate these offer no complete solution.

A recent booklet issued by Commercial Solvents(1) serves to highlight the importance of ammonia to the domestic economy. When these needs are combined with those of a fertilizer-hungry world, and when the possibility of another (explosives-demanding) war is considered, it can readily be seen that the natural-gas-using ammonia plants built during the war are far from the postwar white elephants they were pictured to be at that time.

Growing Use of Oxygen In Gas Synthesis

THE BUREAU OF MINES and the Alabama Power Co. will complete site preparation this fall at Gorgas, Ala., for a second and larger cooperative experiment in underground coal gasification. This field test, for which $441,000 has been allotted for a one-year period, has the following objects: (1) determination of the quantity of coal that can be gasified from a given combustion zone, plus the shape and extent of the burned-out area; (2) determination of the practicability of using fixed outlets for the product gas, either at the outcrop of the coal bed or at vertical bore holes; (3) determination of the quality and quantity of product gas generated under various experimental conditions, also the quantity of tar and other by-products obtained; and (4) obtainment of fundamental technical and economic information concerning plant sites, installations, and operating processes.

In last year's experiments, the gas obtained was of lower than expected heating value, probably because of gas and air leakage through cracks and breaks in the thin (30-ft.) overburden. This leakage will be minimized or eliminated in the new experiments, which will be conducted at depths of 100 ft. or more. Higher temperatures and pressures will aso increase heating values from the 47 Btu. per cu. ft. obtained last year to 70-125 Btu. values, which will be further improved when oxygen and steam are used instead of air.

It is most unlikely that the gas produced will be "rich enough"—contain enough hydrogen and carbon monoxide—for use as synthesis gas for the production of synthetic fuels, ammonia, etc., unless oxygen or oxygen and steam are employed. This requirement is no different than that for surface generators in which coal or coke is to be continuously converted to synthesis gas, and all recent work on quantity oxygen production is being carefully considered (or performed by) workers in the field of synthetic liquid fuels.

In this connection, C. R. Downs, a New York consulting engineer, has stated that seven plants are now be-

(1) Anon., *Ammonia—Its Uses and Properties*, Commercial Solvents Corp., New York, 1948. 48 pages.
(2) Anon., *Activities of the U. S. Department of Agriculture Relating to Disposal and Utilization of Government Synthetic Ammonia Plants for the Production of Fertilizers*, U. S. Department of Agriculture, Production and Marketing Administration, Washington, 1948. 19 pages.
(3) Anon., "New Chemical Company Organized by Phillips," NATIONAL PETROLEUM NEWS 40, No. 29, 14 (1948).
(4) Anon., "Lion Oil to Expand Chemical Facilities," *Chemical Engineering Progress* 44, No. 7, 24 (1948).
(5) Stenerson, Harry, "Behind the Markets—Ammonia Supplies Short," *Chemical and Engineering News* 26, No. 27, 2018 (1948).

ing built to make 90-95% oxygen, their combined capacity being 5220 tons per day (40 billion cu. ft. per year.)(6) Present capacity of plants producing 99.5% oxygen is said to be 15.5 billion cu. ft.

It is highly significant to note that oxygen will shortly be used on a commercial scale (9,000,000 cu. ft./day of 95% oxygen) for the production of synthesis gas from coke at duPont's Belle Works near Charleston, W. Va. This plant produces ammonia, methanol, and other products. Construction of the 360-ton/day plant by the Linde Air Products Co. is expected to be completed in 1949, as will also be the alterations needed to convert existing gas generator sets to a continuous rather than a cyclic basis. This will be made possible by the use of oxygen. Savings in coke consumption, generator maintenance, and generator operating costs are said to justify the cost of construction of the oxygen plant.(7)

Petroleum as Heat Transfer Medium

PETROLEUM SPECIALTIES—industrial oils and the like—are products of increasing importance both to industry and to their producers. In general, however, comparatively little data have been published on them, since those companies which have gone through extensive developmental programs do not care to give their results freely to competitors, so it is chiefly through booklets written for consumer use that the uninitiated can gain some knowledge of the field.

One such booklet, on heat-transfer oils, has recently been issued by the Sun Oil Co.(8) Following a description of heat-transfer methods and heat-transfer media — water, mercury, salt mixtures, and mineral oils—the booklet states:

"Certain mineral oils are excellent heat-transfer media up to approximately 600° F. In properly designed equipment, such oils can be easily circulated for long periods without shutdowns for maintenance. Considering the original cost of equipment, cost of the oil, and cost of maintenance, intelligently selected heat-tranfer oils permit more economical operation than any other medium suitable for use at temperature up to 600° F. It is very important to remember, however, that many high-quality mineral oils that are very satisfactory lubricants are wholly unsuited for use as heat-transfer media."

Desirable qualities are said to include: (1) high boiling point (so long as high percentages of tars and other undesirable gummy products are not present as contaminants), (2) low enough viscosity to permit easy circulation, (3) stability in use at high temperatures, (4) ability to permit water picked up in use "to drop out quickly so that it can be removed from the system."

Survey of University Patent Policies

IN THESE DAYS of increased emphasis upon research, many companies in the petroleum field and elsewhere are turning more and more to the technical and scientific institutes of this country for the investigation of specific research and developmental problems. To meet this demand, many universities have established research institutes within or closely allied to their engineering and scientific colleges. Since neither the universities nor the companies have had much time or experience in these matters, it is not at all surprising that a diverse and conflicting set of practices has grown up from institute to institute.

The matter of charges for this type of research was discussed in this series last year, it being noted that the charges varied somewhat in relation to the completeness of the patent rights granted to the sponsors. It is therefore quite interesting to note the publication of an extensive survey(9) on university patent policies, prepared by the National Research Council.

This survey does not attempt to reach definitive conclusions in this field. Instead, it discusses the subject thoroughly under the various divisions which pertain to it and presents formalized patent policy statements for the 37 universities which have established set patterns. There is no doubt that industry would welcome uniformity in what is in reality a business matter, and this survey, through its factual presentation of the subject, is a step in that direction.

NAM Reports on Trends In Industrial Research

WHILE EACH COMPANY in a given industry must always decide for itself how much research it can afford to do—unfortunately, the figure selected is usually the smallest that the company dare set—it is always informative to know what other companies are doing in this regard, both in the same field and in others. For this reason, a recent study of "Trends in Industrial Research and Patent Practices" (10) is attracting considerable attention.

This study is based on the answers of 983 manufacturers who replied to the NAM questionnaire. Of this group 750 reported that they carry on a research program, many on a scale far greater than before the war. Anticipated 1947 research expenditures for the whole group showed an increase of 270% over 1939. "In general, the survey indicated that companies with sales of less than $1,000,000 a year are spending a greater proportion of their sales dollar on research than concerns with sales above this figure." In 1946, concerns with research programs spent an average of 1.87% of their sales dollar on industrial research—about the same as in 1939, hence indicative of the far greater dollar volume of research.

The petroleum and coal industries were lumped together for the purposes of this study, so it is probable that the figures included are somewhat lower than for the petroleum industry alone, since petroleum companies are more active in regard to research than are coal concerns. Of the 21 companies in this joint category which replied to the questionnaire, 18 (86%) have research programs. Research expenditures anticipated for 1947 were 276% above the 1939 level (19% above the 1946 sum).

Significant of the increased tempo of research in both fields is the increase in the ratio of research expenditures to sales. While this ratio is and has been well below the average for all industries, "it has almost doubled since 1939, increasing from 0.41% to 0.74% in 1947. . . . The survey shows that the largest increase in the average ratio has been by companies refining petroleum with sales over $25,000,000, as it rose from 0.41% in 1939 to 0.68% in 1946 and 0.78% in 1947. While the ratio has been around 1% of sales for several such concerns, still some report percentages as low as 0.15%."

The ten petroleum and coal companies which had sales of more than $25,000,000 had an average of 651 research employees. Of the 18 concerns with research programs, 17 (95%) had their own research laboratories.

Most of the petroleum and coal industry research (53%) is intended to be of immediate benefit. The great majority (80%) feel that higher research expenditures ultimately result in higher sales; most of the companies emphasized the development of new products as the principal objective of their research program.

(6) Anon., "Costs of Tonnage Oxygen Discussed," *Chemical Engineering Progress* 44, No. 7, Suppl. p. 20 (1948).
(7) Anon., "Linde Building A Large Oxygen Unit at Belle," *Chemical Engineering* 55, No. 6, 183 (1948).
(8) Anon., *Circo XXX Heat-Transfer Oil*, Sun Oil Co., Philadelphia, 1948. 13 pages.
(9) Palmer, Archie M., *Survey of University Patent Policies* (Preliminary Report), National Research Council, Washington, 1948. 168 pages.
(10) Anon., *Trends in Industrial Research and Patent Practices*, National Association of Manufacturers, 1948. 79 pages.

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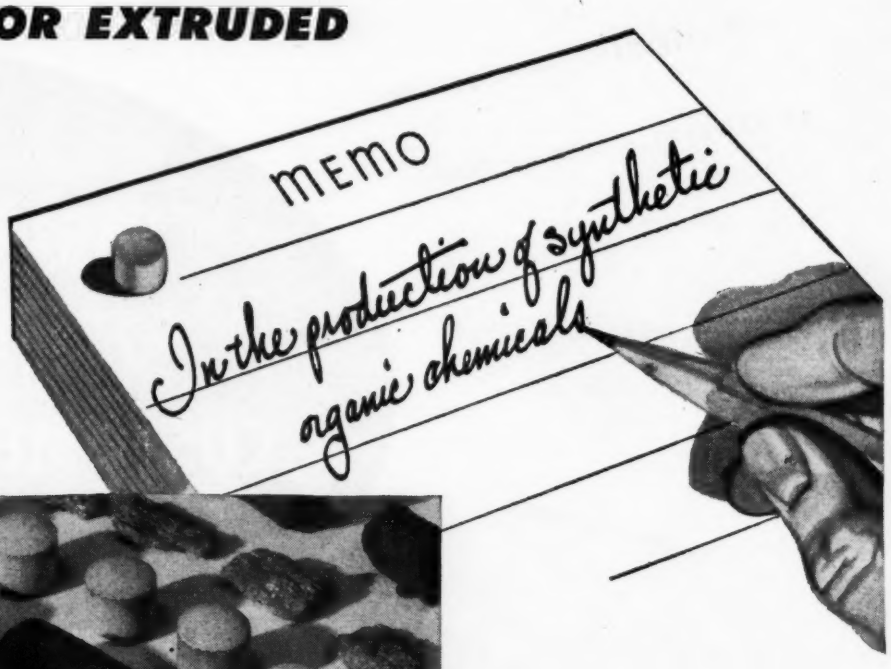

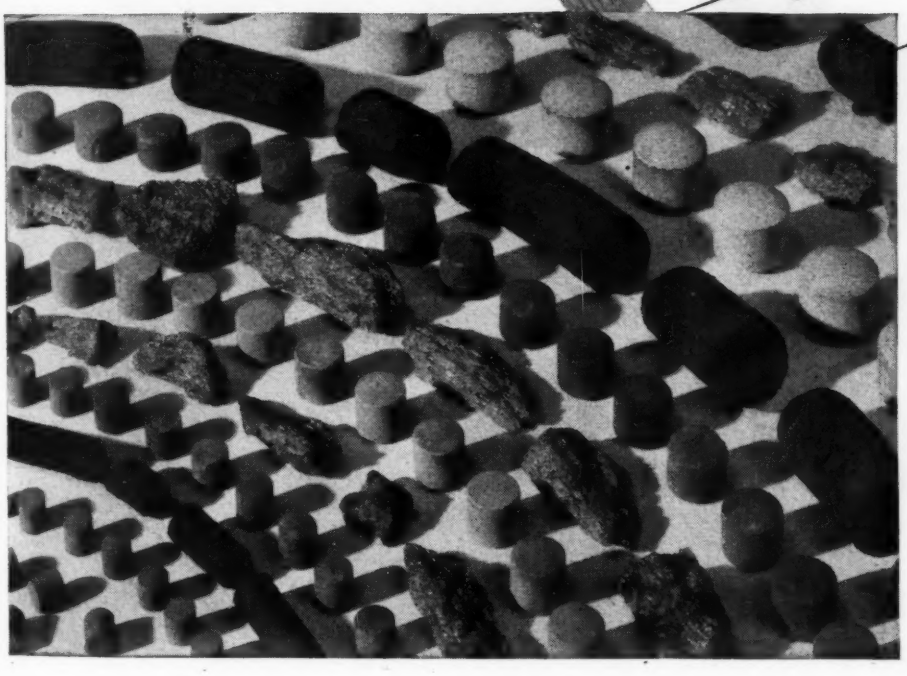

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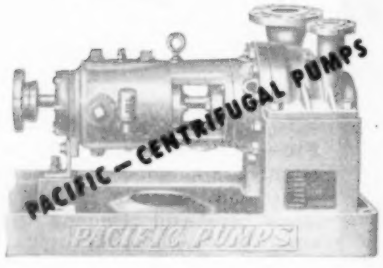

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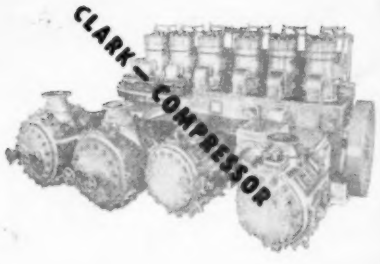

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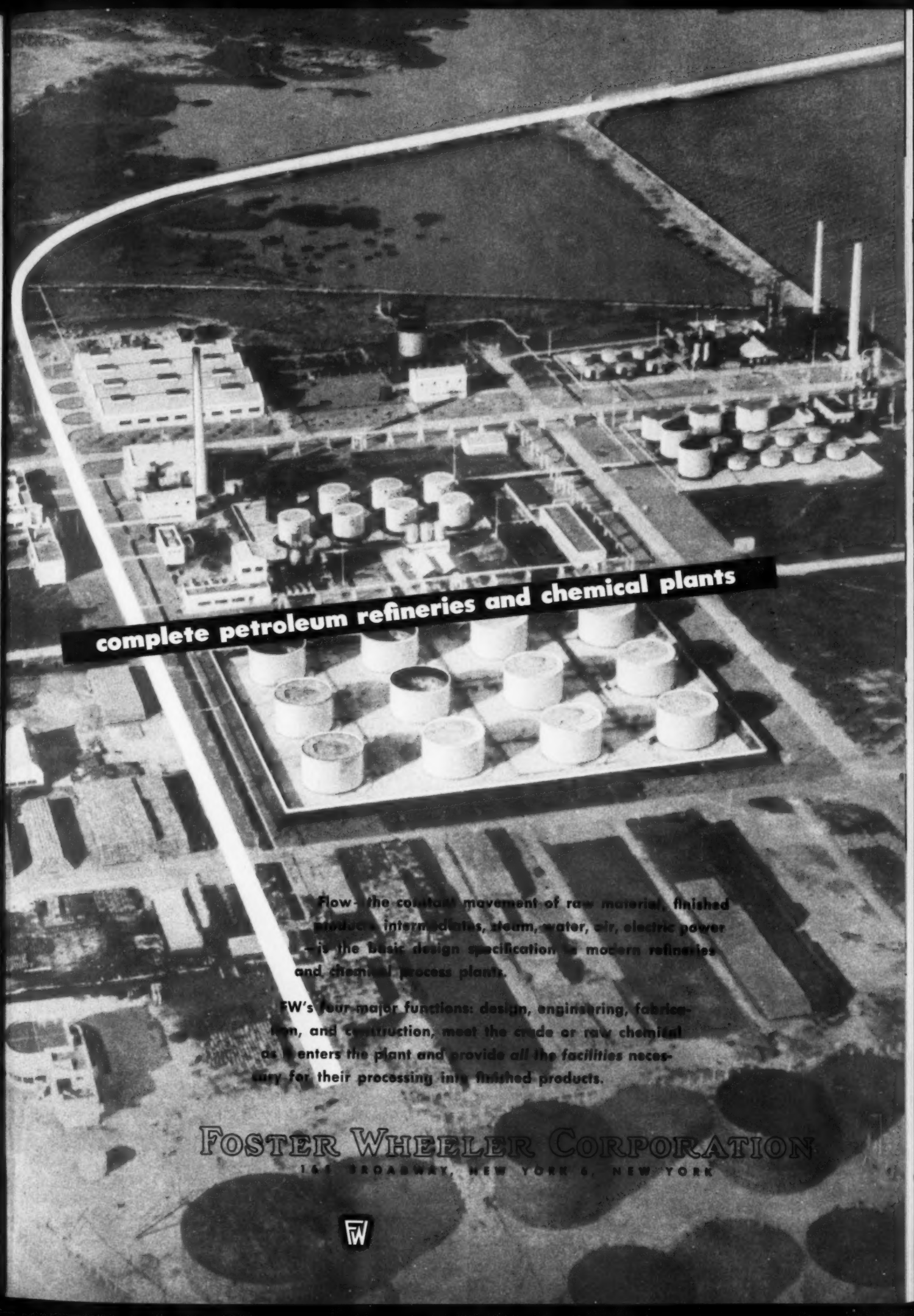
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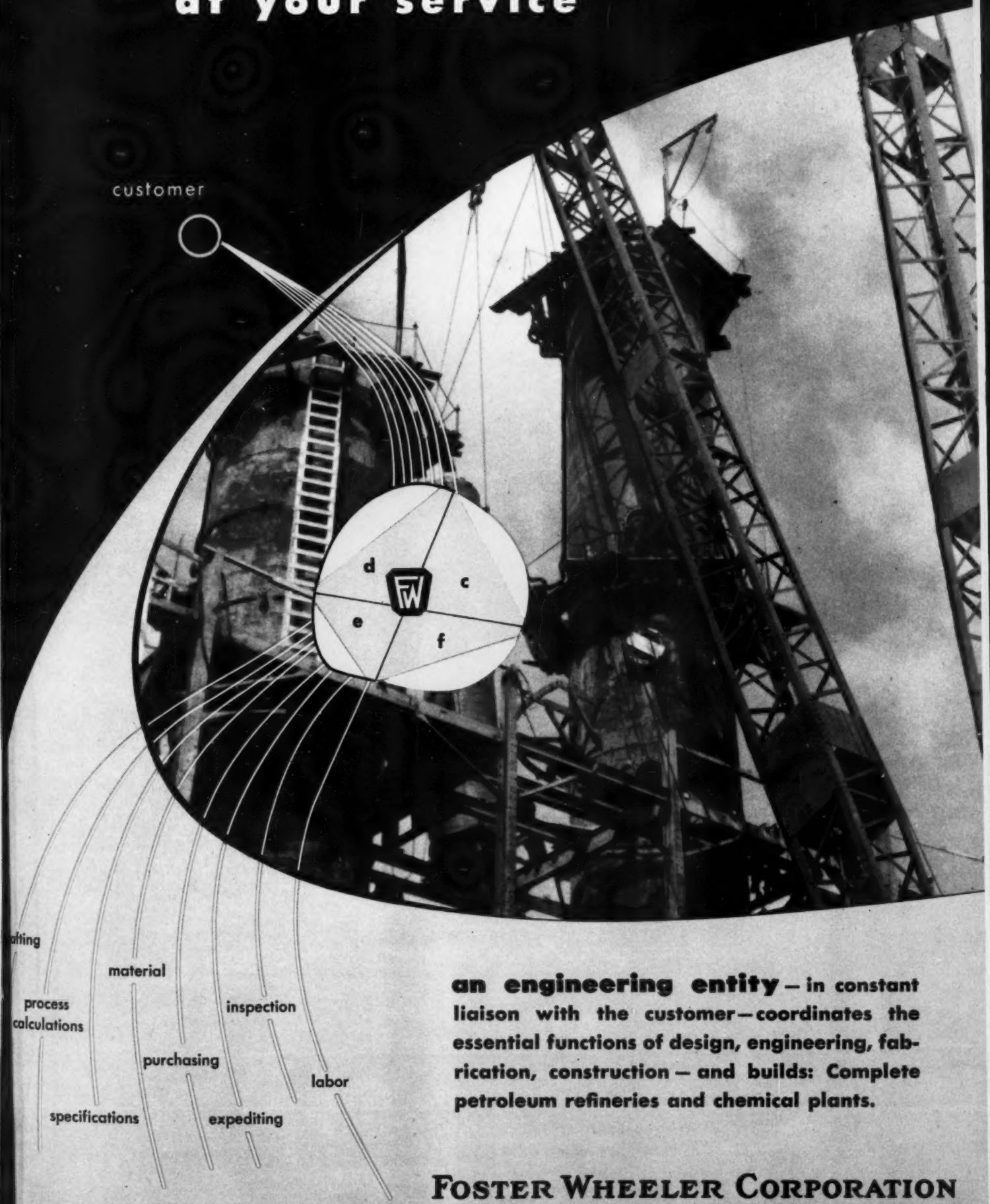

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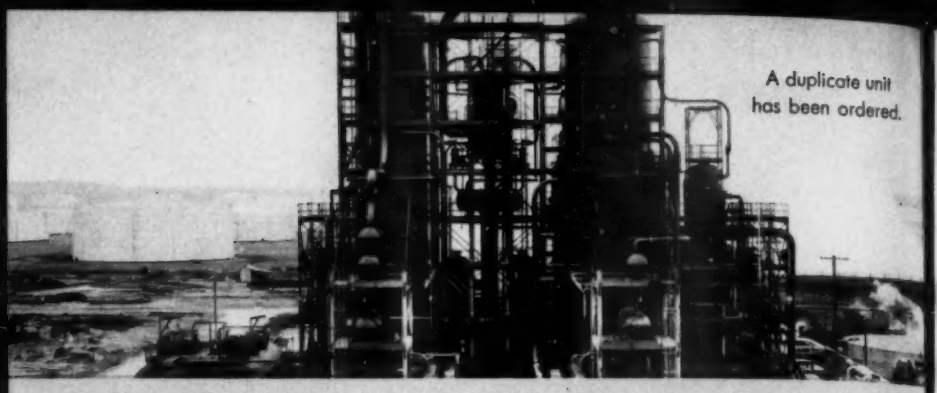

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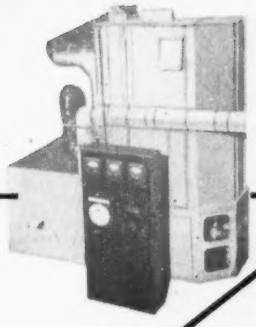

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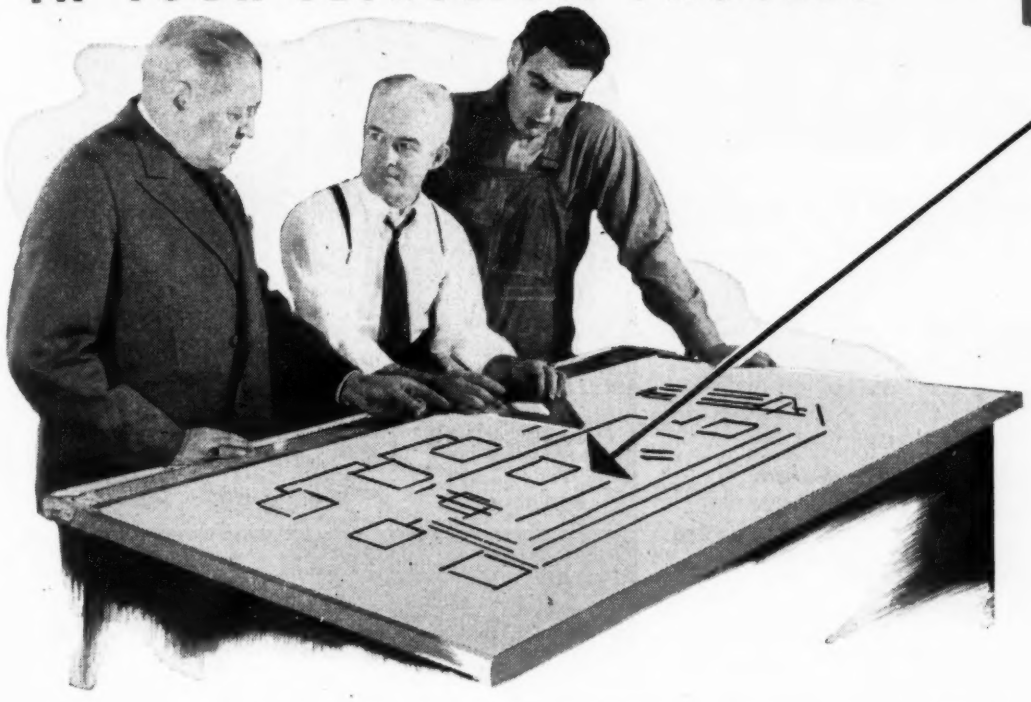

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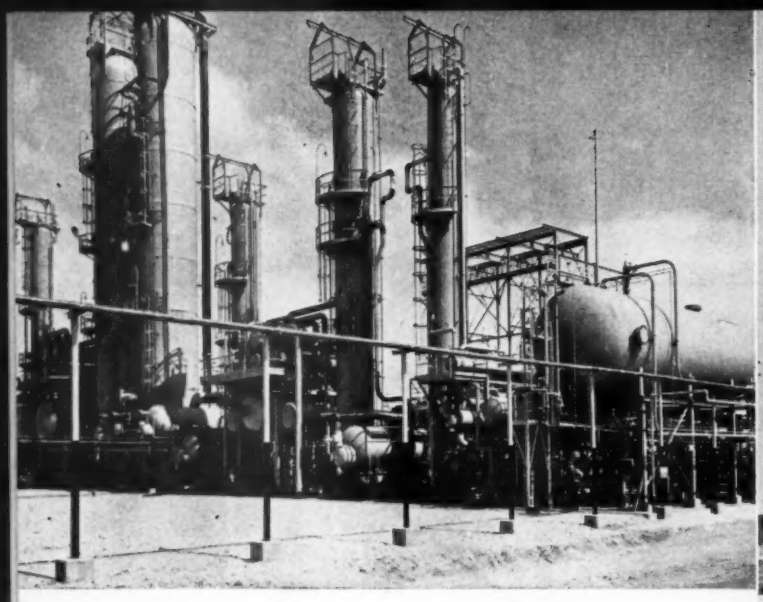

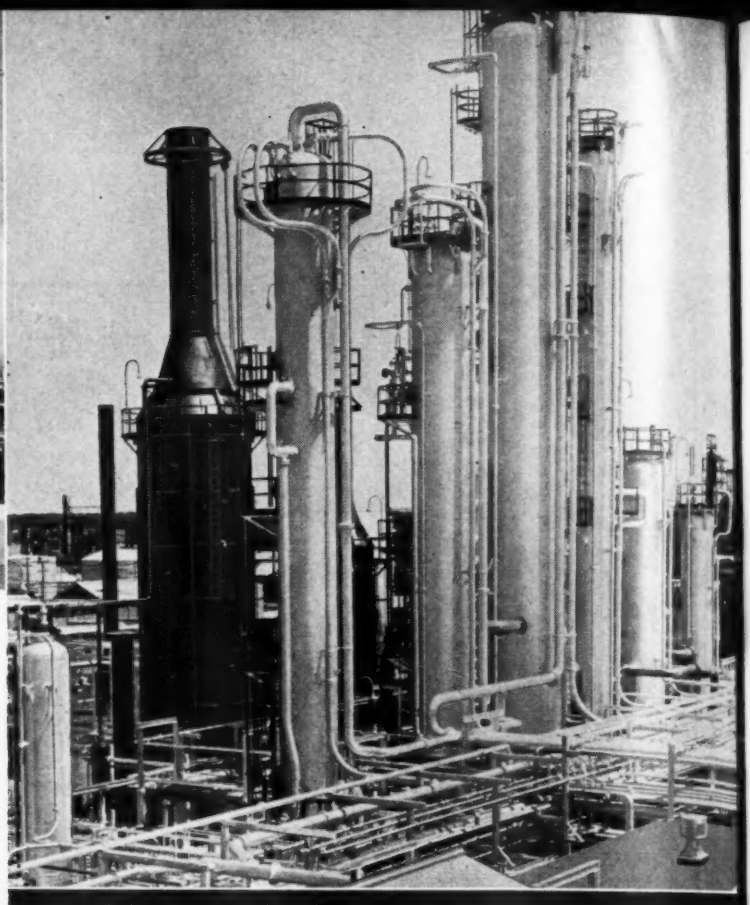

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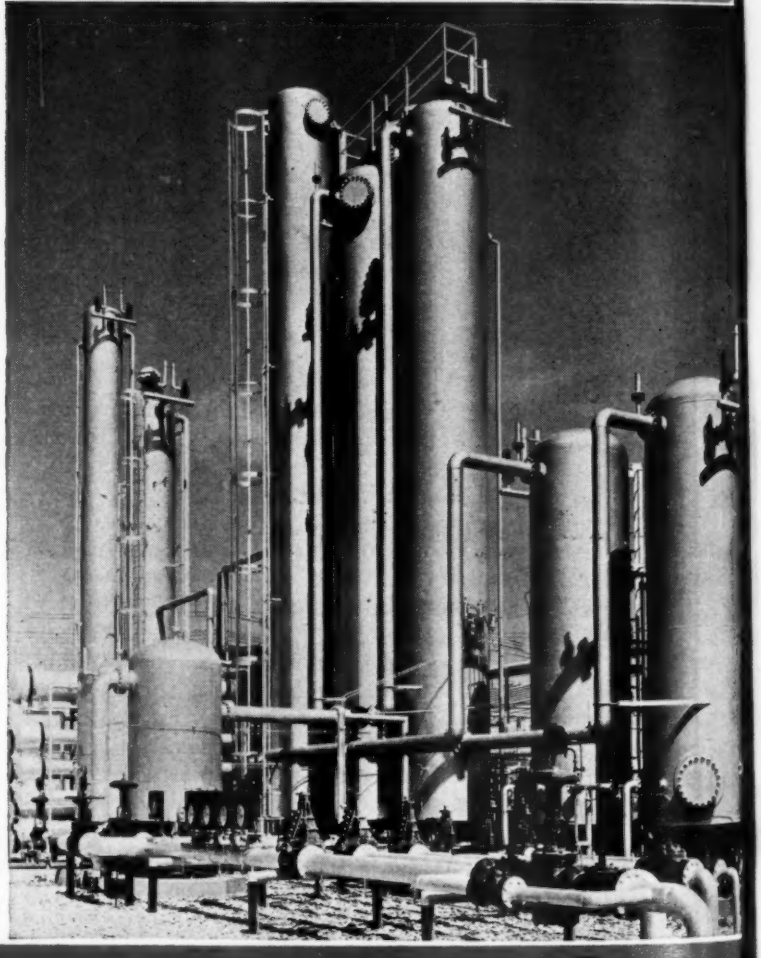

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New Federal
WATER POLLUTION CONTROL ACT
–Its Significance to Petroleum Refiners

By W. B. HART,
Service Superintendent, Atlantic Refining Co., Philadelphia

The significance to petroleum refiners of the new federal pollution abatement law is analyzed for *Petroleum Processing* readers by the oil industry's leading authority on waste disposal.

The functions of the U.S. Surgeon's office and of the individual states are described. Considerable latitude in defining "pollution" is provided in the statute to include such conditions as propagation of fish and aquatic life, and recreational purposes, among others. The emphasis placed upon such factors will determine how far the refining industry must go in its treatment of plant wastes.

Mr. Hart, service superintendent for Atlantic Refining Co., and in charge of that firm's waste disposal program, for many years headed the pollution control program of the API Refining Division. He is author of the series on Refinery Waste Disposal which appeared in *Petroleum Processing* and has lately been republished in book form.

There have been numerous persistent efforts to secure the enactment of federal legislation on various subjects, but probably none over a longer time than that to obtain a federal law on the abatement of water pollution.

Even before the turn of the century, water pollution had become such a general problem that Anti-Pollution bills were introduced in Congress in 1897. Pollution abatement legislation, in the form of at least one bill, has been introduced into each session of Congress since that time.

The war was the indirect cause of a greater degree of stream pollution in many sections of the country than had been experienced before. Consequently, the proponents of what many industrial people regarded as drastic legislation acquired increased strength. This put the supporters of the "legislation with teeth" in such an advantageous position that their opponents were willing to compromise and the result was the Barkley-Taft Anti-Stream Pollution Bill (S-418), passed by both Houses of Congress and signed into law by President Truman on June 30, 1948.

That the new federal pollution act is a compromise becomes evident in the very first section. The matter of states' rights was a prominent feature of all the debates during the past several years. In the bill finally enacted, the primary responsibilities and rights of the states are protected and preserved by declared policy of Congress. The law then divides, in purpose, into two parts. In one part the technical features of the water pollution problem are collected under the direction of the U. S. Surgeon General. In the other part, the mechanics of loans and grants under the Federal Works Agency is described.

The responsibilities placed upon the Surgeon General, in large degree, are those which were prescribed in earlier "study" types of bill. They consist of conducting research and investigations, but in extended scope. In cooperation with state agencies, interstate agencies and with municipalities and industries involved the Surgeon General is to prepare programs for pollution abatement.

These programs are to give due regard to the "improvements which are necessary to conserve such waters for public water supplies, propagation of fish and aquatic life, recreational purposes, and agricultural, industrial, and other legitimate uses." It is this part of the act from which, by inference, pollution in the eyes of the act is defined. This is important to the petroleum industry.

Federal Action Possible

Under Part 2, Section 2, the Surgeon General is obligated to notify those causing pollution, which has been declared to be a nuisance after investigation, to abate the pollution within a reasonable time and to a reasonable degree. He is required also to notify the state agency of the state in which the pollution is occurring. He also may recommend methods for its abatement.

If the first notice does not get results after a *reasonable* time, a second notification is sent, and the state is made aware of this notice also. This notice to the state may include a recommendation that suit be instituted. If the second notice is ignored by the offending establishment for a *reasonable* time, and also if the state fails to take action, the Federal Security Administrator is *authorized* to hold a public hearing in the locale of the pollution, before a board appointed by the Administrator and consisting of officers or employes of the Federal Security Agency or of the interested state or interstate agency, and a representative of the Department of Commerce. A majority of the board must be persons other than officers or employes of the Federal Security Agency. Based upon the evidence presented at the hearing the Security board shall make recommen-

dations to the Federal Security Administrator as to what steps, if any, it finds to be reasonable and equitable to abate the pollution.

After giving the person or persons involved a *reasonable opportunity* to carry out the recommendations of the board, and if he or they do nothing, the Federal Security Administrator, *with the consent of the State Agency*, may request the Attorney General to bring suit on behalf of the federal government to secure abatement.

The important features of this act, insofar as industry, and particularly the petroleum industry, is concerned, all come in the first five sections. The act in itself is not nearly as strict as many of the state laws, but of course, it is national in scope. It is an act which well could stay on the books for years without much effect in the way of accomplishment. The wording of the act is rather vague; it is filled with the phrases "Reasonable Time", "Reasonable and Equitable Measures", etc. These statements say little, and leave wide open room for individual opinion as to what they mean. Consequently, the entire effectiveness of the Water Pollution Control Act appears to depend, as with many of our laws, upon its administration. There are several possibilities.

The organization of the Pollution Control Advisory Board may result in the formulation of a policy of watchful waiting to see what the various state agencies will do in pollution abatement measures. Under such circumstances much state activity probably will consist of a scramble for funds appropriated by the act, with some states making no effort in this direction.

State Activities May Increase

As a second possibility, the state agencies may step up their pollution abatement activities because they feel there is a club over their heads, even though the club is pretty well padded and held some distance away. If the federal act is not actively administered it is quite likely that any spurt in state activity will not be long lived, for it will be realized that the Surgeon General can do little of his own volition for some time. All the earlier pressure steps in the act require state agreement. There is one procedure by which the Surgeon General will have opportunity to exercise some degree of control in the situation. Either as an attempt at retaliation for inactivity, or through politics, the Surgeon General can block the effort of any state to obtain loans or grants. The net result of such a procedure probably would be no gain in pollution abatement in the inactive state.

State agencies may, and probably will, react differently under the new law. These agencies are interested in maintaining their status and they tend to guard their prerogatives zealously. A number of them were firmly entrenched in the ranks of the "states' rightists" during the earlier controversies over water pollution abatement. In this position they were right in principle in many instances but, without grouping of individual states into interstate watershed compacts and similar agencies, the position of the states became one of nonuniformity on policies and in some instances stream recovery was actually retarded.

State Positions More Equal

With the new Water Pollution Control Act all states essentially are in the same position. The Surgeon General can call upon them to co-operate in an investigation of both ground and surface waters. He is not restricted to interstate waters, but also has the power to examine into the condition of practically any ground or surface waters inside the state lines, and to promote programs for their protection. This will mean programs for the treatment of sewage and industrial wastes.

If any state, political subdivision, or industrial establishment does not elect to heed notices sent to them, the state agency or the establishment may be brought into a public hearing. This, neither the state nor the industrial establishment, particularly the latter, will care for. Consequently, the recent legislation, to this extent, will serve to bring activity in all states where pollution exists—provided it is effectively administered and in accordance with its seeming intent.

The impact of this upon all industry would seem to be an impetus to go ahead with the installation of water treating plants while there is opportunity to think them out carefully as to design and construction, rather than to be driven into providing such installations under stress of investigation, public hearing and suit.

Another effect upon industry is possible under this act. In developing programs for the improvement of sanitary conditions of surface and underground waters due regard shall be given to conservation of the waters for public water supplies, propagation of fish and aquatic life, recreational purposes, agricultural, industrial, and other uses. The emphasis to be placed upon the first three of these uses will determine much of the answer to the question, How far must the refining industry go in the treatment of its wastes?

This answer is a matter of the present and also projects itself into the future. There are in existence today industrial waste treatment plants which were installed either without proper pre-design survey, or by designers lacking experience in industrial waste treatment and stream protection, or, under pressure to meet a required operating date, and without benefit of survey or experience. It is conceivable in many cases, and almost assured in some, that these plants are producing effluents which will not be satisfactory with respect to conservation for use as water supply, aquatic life environment, or recreation, even though these effluents might not be strictly construed as water pollutants. Considerable hardship to industry could develop under this provision of the act.

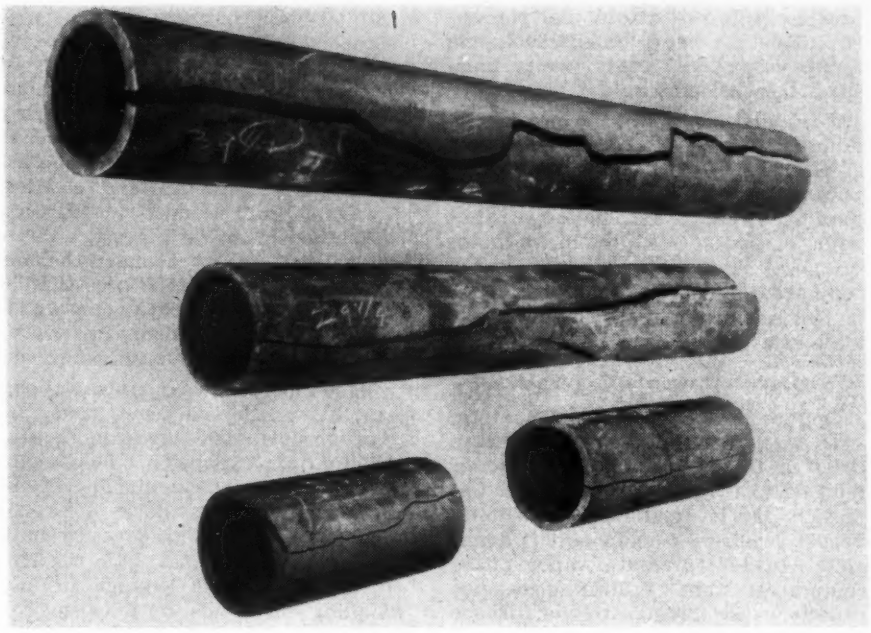
Time to Take Stock

It will be some time before the various activities established under the new Water Pollution Control Act can be organized. Also, it will be some time before the new laboratory provided for in the act can be built and equipped. This laboratory is to be located in Cincinnati. During this period all industry best can serve itself by taking stock of its position, and its relationship with its state agencies. The petroleum industry also should carefully examine its position with respect to its wastes other than oils, and also with respect to such standardized equipment as has led it to a feeling of security in connection with oil pollution. Some of this equipment may be satisfactory, but some may not, because the other wastes are not those which the equipment is designed to handle.

All could be made rather simple. If the aquatic life in a stream were made the gauge of stream condition, it would be found that waste treatment to provide *reasonable* stream condition is not too serious to attain, and that a common level of water resource protection that would last for years would be available for use by all agencies, and all sources of potential pollution. All could speak the same language, and such a condition is absolutely essential to the solution of any problem as broad in scope and as serious in nature as is the problem of water pollution abatement.

Write for YOUR Copy Of New Pollution Act

Readers may secure copies of the new Water Pollution Control Act (Public Law 845), signed by the President June 30, without cost by writing PETROLEUM PROCESSING, 1213 West Third St., Cleveland 13, Ohio. Copies are immediately available.



Typical of one kind of failure are these fractures in plain 5% chromium steel alloy tubes subjected to "temper-embrittlement" by excessive operating temperatures. Fractures occurred during cleaning when tubes were cold. Difficulty has been remedied by incorporating molybdenum in 5% chromium analysis

REFINERY TUBE FAILURES

Excessive Temperatures Found Chief Cause

THE MOST common causes of failure in pressure type tubes for all kinds of refinery equipment, regardless of the metal used—carbon or alloy steels—are corrosion, scaling, and creep-rupture due to *excessive temperature.*

This statement and the following information are from a new booklet on the properties of tubing for high temperature and high pressure service, published recently by the Babcock & Wilcox Tube Co.[1] It is based on innumerable studies over a period of 25 years of tube failures in service in power boilers and all types of petroleum processing equipment, the report states.

While other factors enter into the overall picture of causes for tube failures, the problem of overheating has been found to be predominant. For example: the following itemized list taken from records of refinery heater tube failures indicate some of the reasons for excessive metal temperature and attendant failure in petroleum conversion equipment:

1. Excessive transfer rates in furnace equipment.
2. Coking of tubes—either expected or extraordinary.
3. Increase of pump pressure to maintain throughput.
4. Failure to clean tubes at regularly scheduled periods.
5. Unexpected radiation from bridge wall as refractory surfaces.
6. Improperly calibrated fuel meters on burner equipment.
7. Increase of product temperature over a safe design limit.
8. Unequal heating around circumference or along tube length.
9. Excessive furnace temperatures.
10. Guessing at tube metal temperatures.
11. Lack of control of furnace atmosphere to retard scaling.
12. Abuse during mechanical decoking, or scaling during burnout operations.

Some of the above items are corollary with others and most of those enumerated are in the direction away from maximum economy of operation. Some compromise is necessary in this connection to avoid continual tube trouble. Other items giving trouble during operation and tending to reduce life and increase maintenance costs are:

1. Improper supports resulting in bending or sagging.
2. Corrosion of ends or body of tube or both.
3. Leaky header seats.
4. Carburization, followed by casting off of carburized layer.
5. Abrasion or erosion due to coke in fluid stream.

The stronger, more corrosion-resistant alloy steels have contributed to increased safety and longer life, but part of these advantages over carbon steel have been used up in meeting the demands for higher temperatures and pressures in the newer processes. The very nature of thermal cracking is such that coke and residue formation may and will occur in the tubes under certain circumstances. Again, in certain processes much of the cracking is obtained within the tubes rather than in the reaction vessels. In the coking process, in heavy oil cracking, in reforming, and in many vapor phase operations, coke may form rapidly or slowly, giving rise to increased metal temperature and liability to failure.

The report urges caution in operation regardless of the metal employed in the tubes because both carbon and alloy steels will fail under abusive circumstances. Variations of several hundred degrees in actual metal temperature of tubes may arise from beginning to end of a still run, and a wide variation in metal properties with such temperature change may be expected. When such temperature differential is expected and allowed for in design of equipment, the imposing of a slight *additional* temperature increase — either inadvertently or purposely to improve product or maintain throughput — may

(1) "Properties of Carbon and Alloy Seamless Steel Tubing for High-Temperature and High-Pressure Service," Technical Bulletin No. 6-E; The Babcock & Wilcox Tube Co.

lead to failure of a tube and perhaps a costly fire; snuff lines, check and dump valves, and other safety measures notwithstanding.

Examination of a considerable number of failed carbon and alloy steel tubes up to and including 25% chromium-20% nickel secured from many refineries has indicated that while corrosion is a prominent factor in tube life, it may be satisfactorily combatted by conventional techniques of neutralization treatment or proper alloy selection.

Vigilance Prevents Overheating

On the other hand, over-heating, with attendant bulges, splits, or ruptures of tubes can only be offset or reduced to a minimum by proper operation and vigilance, assuming properly designed equipment is available. In low pressure vapor phase equipment, tube failure does not usually cause damage to the furnace or its parts, but a high pressure failure, in either gaseous or liquid phase, can be serious. For example: excessive carburization of the bore of the tube may occur even in stainless steels when temperatures exceed about 1350° F., resulting in casting off of carburized layer and embrittlement of the metal itself.

The report discounts the belief that carbon steel tubes in any kind of service will swell and fail with only a slight split under excessive temperature conditions as contrasted to more disruptive failure of certain alloy steels.

Failures of various kinds have been observed in carbon steel. Some are of the intergranular, very slow type fractures, occurring over an extended period of time with little evidence of swelling of the tube. Others include those which have bagged or swelled and finally failed with small splits at the bagged areas; and finally those having wide open breaks several feet in length. All varieties depend on circumstances, ranging from long-time creep style to those of short duration wherein the tube becomes, in effect, simply a short-time elevated temperature tensile test specimen.

Some Determining Factors

In this latter case, the length of the rupture is dependent to some extent on the uniformity of temperature of the overheated section and to the pressure within the tube. High pressure may cause a tearing action resulting in a break of large dimensions. So-called creep failures occur where temperature is maintained for long periods just a few degrees above a safe operating level.

Certain alloy steels will fail similarly with relatively little expansion of diameter, again depending upon conditions of temperature, pressure, and rate of deformation. The alloy designed for high temperature use will, of course, operate under conditions where carbon steel will scale rapidly and suffer excessive creep. Steels of the austenitic stainless type usually exhibit poorer ability to undergo slow deformation than the ferritic low alloy steels, but because of their high resistance to creep, scaling, and corrosion, are employed under the most severe temperature and pressure conditions. When properly operated in well-designed equipment, the austenitic variety will give excellent service.

Tube ends in heater coils, although usually outside the firing zone, may give trouble due to leakage from differential expansion, because of poor fit and workmanship, or because of improper rolling or expanding of the joint. High pressure units, as might be expected, give the most trouble and slight leakage in units handling oil fluids may cause coke deposits to build up, giving rise to increased leakage or causing actual collapse or deformation of the tube. Thin alloy liners inserted in tube ends to reduce end-corrosion have been known to collapse from this cause. Improper tube seats or fit in steam units at headers or drums may lead to cutting or grooving of the seat and tube from high pressure steam or water.

"End-Corrosion" Is Common Trouble

One of the most common causes of trouble in oil cracking coils or heaters is the so-called "end-corrosion" due to turbulence and change of direction of the fluid stream resulting in greatly increased corrosion and erosion of the metal at and near the ends of tubes. Such corrosion is usually non-uniform, and pits and undercuts the tubes so that renewal must be made more frequently. End-corrosion usually can be eliminated or reduced substantially by employing a more corrosion-resistant steel either safe-ended to a lower alloy or carbon steel tube, or by use of a full-length tube of the higher alloy.

Cold brittle failures due to cleaning, knocking, or deforming during cold weather may occur in certain alloy steels. However, this condition is not generally troublesome with the chromium - molybdenum types now in general use. Steels which are subject to the development of cold brittleness may be protected by cleaning or deforming while warm; i.e., over 200° F., as the mild temperature restores toughness to the metal. These tubes may become bulged or heavily scored by careless cleaning operations especially if conducted when the metal is warm, and thereafter will give trouble at these areas during operation. In the air-steam decoking method of cleaning, precautions should be taken to avoid excessive temperatures.

As a result of the long period of study on the various steels and alloys, B & W engineers have worked out a series of recommendations for proper applications of these materials:

RESUME OF APPLICATIONS*

CARBON STEEL (KILLED)

Carbon steel is suitable for usual operation where mildly corrosive conditions prevail. It has low strength properties. It is not recommended for steam-superheater service above 950 F. metal temperature or for oil-still service above 1050 F. because of progressive oxidation, even where its strength may be sufficient for the application.

CARBON-MOLYBDENUM STEEL (0.50% Mo.)

This material is equivalent to carbon steel in its corrosion-resistant properties. It has good strength properties. (Because of low resistance to oxidation, may need protection by calorizing to take full advantage of strength properties.) Not recommended for steam service above about 975 F. metal temperature or in oil cracking above 1050 F., because of low resistance to oxidation. C-Mo steel is quite useful for steam lines because of ease of welding; also in oil-refinery heaters and for miscellaneous high-temperature piping providing it is employed in services where corrosion is not severe. C-Mo steel may be subject to graphitization depending on temperature and method of deoxidation during manufacture.

Ferritic Group

(CROLOY ½) 0.50%-0.70% Cr, 0.50% Mo.

This low alloy steel is interchangeable with carbon-molybdenum steel and has comparable strength properties and resistance to corrosion. Croloy ½ is superior to the carbon-molybdenum grade with respect to graphitization and high-temperature load carrying ability. It has satisfactory resistance to steam oxidation at temperatures not exceeding about 1000 F. Maximum service temperature in oil-refinery service should be limited to 1075 F. This steel is principally used for high-temperature steam piping where its ready weldability is particularly advantageous.

*When the steels listed in this resume are subjected to highly sulfurized atmospheres the maximum permissible temperature should be revised downward, as the presence of appreciable quantities of sulfur in the products of combustion tends to increase the rate of scaling. The temperatures given may be considered satisfactory as a general guide, but the user is cautioned that these temperatures might not hold in all cases.

(CROLOY 1¼)**
1.25% Cr, 0.50% Mo, 0.75% Si

This is an economic grade having good creep-strength properties. It is somewhat more corrosion resistant than the chromium-free steels and has fair resistance to oxidation. Application of this analysis has been declining over the past several years due to greater overall economy of CROLOY 2¼, especially in so far as oil-refinery furnace tubes are concerned. Recommended maximum temperature limit in steam service, 1025 F.; in refinery tubes, 1100 F. It is available in both open-hearth and electric furnace qualities.

(CROLOY 2)
2% Cr, 0.50% Mo.

This analysis has good resistance to oil corrosion and has found widespread use as an economic grade in both steam-generating and oil-refining equipment. It has good creep-strength properties and offers considerable advantage over plain C steel and carbon-molybdenum steel, with respect to oxidation resistance. Maximum service temperature in steam should be limited to 1080 F. and, in refinery applications, to 1150 F.

(CROLOY 2¼)
2.25% Cr, 1.00% Mo.

This alloy offers extremely high creep properties and, in this respect, *is the best available steel exclusive of the austenitic* CROLOYS. Otherwise, it is quite similar in characteristics to CROLOY 2. It is useful for high-pressure cracking of non-corrosive stocks, thermal polymerization and alkylation, to which it is being applied in increasing quantities. Suitable for steam application to 1025 F. metal temperature, or in furnace tubes, to approximately 1175 F.

(CROLOY 3-M)
3% Cr, 0.90% Mo.

This is an intermediate grade between CROLOY 2 and 5, with good creep-strength properties and somewhat more corrosion-resistance than CROLOYS 2 and 2¼. For 1000 F. to 1050 F. metal temperature in steam, or to 1175 F. in refinery applications.

(CROLOY 5)
5% Cr, 0.50% Mo.

This alloy has good resistance to oil corrosion and is a standard, widely used steel for refinery tubing application in both furnace tubes and piping. It has fair creep-strength properties and reasonably good resistance to oxidation. Used also for steam superheaters. The temperature limit in steam is about 1050 F. metal temperature, and, in refinery applications, 1200 F.

(CROLOY 5-Si)
5% Cr, 0.50% Mo, 1.50% Si

This is a modified form of CROLOY 5. It has good corrosion resistance, fair high - temperature strength, and better oxidation resistance than CROLOY 5. Maximum temperature limit approximately 1300 F. Suitable for air-heater tubes and similar applications. This alloy is not as resistant as CROLOY 5 in steam atmospheres.

(CROLOY 5-Ti)
5% Cr, 0.50% Mo, Ti Stabilized

This alloy has better oxidation resistance than CROLOY 5, has fair strength properties and good corrosion resistance. It is non-hardening to 1700 F. and is, therefore, somewhat easier to handle than CROLOY 5 in certain forms of construction, and, for this reason, has been used in super-heaters involving welded construction. It has certain undesirable properties, due to the titanium addition, which result in occasional seams and splits. It is, therefore, not too favorably regarded in tube manufacturing and for certain applications. Maximum service temperature about 1250 F.

(CROLOY 7)
7% Cr, 0.50% Mo, 0.50-1.00% Si

This alloy is intermediate between CROLOYS 5 and 9, having better oxidation and corrosion resistance than CROLOY 5 and equivalent high-temperature strength properties. Contains 40% more Cr. than CROLOY 5 at a small increase in overall cost. Maximum service temperature approximately 1250 F. Its use is especially indicated in oil-refinery application where greater corrosion resistance than that possessed by CROLOY 5 is wanted.

(CROLOY 9M)
9% Cr, 1% Mo.

This alloy offers very good corrosion resistance with good high-temperature strength and is for service where such qualities are necessary. It also has good oxidation resistance and may be used to 1300 F. maximum. It may be considered a substitute for the more expensive stainless grades, especially with regard to sulphide corrosion as encountered in oil refineries. Good resistance to steam oxidation up to 1100 F.; also especially adapted for hydrogenation processes.

Austenitic Group

(CROLOY 18-8)
18% Cr, 8% Ni

This popular stainless alloy offers excellent corrosion and oxidation resistance and very high strength. It has been in wide use for fifteen years in petroleum refining and other high-temperature applications up to 1600 F. maximum metal temperature. In some cases, the stabilized alloy containing titanium or columbium may be preferred.

(CROLOY 16-3-3)
16% Cr, 13% Ni, 3% Mo.

This alloy—developed initially for chemical corrosion service — offers extraordinarily high creep - strength properties combined with excellent corrosion and oxidation resistance up to 1600 F.

(CROLOY 25-20)
25% Cr, 20% Ni

This alloy — the ultimate of the present CROLOY group—offers the maximum in oxidation resistance at temperatures approaching 2100 F., with - excellent corrosion resistance and strength properties. It offers also good resistance toward carburizing effects by virtue of its high nickel content.

The B & W Technical Booklet

The new Technical Bulletin No. 6-E, "Properties of Carbon and Alloy Seamless Steel Tubing for High-Temperature and High-Pressure Service," contains considerable valuable engineering information, data, charts, and tables in addition to that on which the accompanying article is based.

The bulletin is the sixth edition of Babcock & Wilcox Tube Co.'s Technical Bulletin No. 6, and makes available data accumulated since the last previous edition was published in 1941. It includes results of research and development on all alloy and other steel tubing manufactured by B & W for high temperature and pressure service such as is represented by petroleum processing equipment. Information presented includes (1) effects of various major alloying elements on steel, (2) chemical composition, (3) room temperature properties, (4) short-time tensile properties, (5) stress - rupture tests, (6) creep data, (7) S-values, (8) thermal expansion and conductivity data, (9) impact properties, (10) microstructure, and (11) effect of hydrogen.

Readers who wish a copy are requested to write on company letterhead direct to Babcock & Wilcox Tube Co., Beaver Falls, Pa.

**The steels from CROLOY 1¼ upward are electric furnace melted alloy steels which are normally cleaner and of better quality than those melted in the open hearth. This contributes to greater reliability and improved creep properties at elevated temperatures.

Engine Warm-Up Test Provides New Tool For Evaluating Gasoline Volatility

AN ENGINE warm-up test developed in the Research and Development laboratories of Gulf Oil Corp., Pittsburgh, is proving an important tool for use by both refiners and engine designers in evaluating gasoline volatility in terms of actual engine performance.

The Ethyl Corp. participated in a later stage of the test program, which was carried on in the cold room at its Detroit research laboratories. Data on the new warm-up test and results were presented before the Summer Meeting of the Society of Automotive Engineers, at French Lick, June 6-11, in a paper by J. E. Taylor, assistant chief automotive engineer, Gulf Research & Development Co., and H. J. Gibson, research coordinator, Ethyl Corp. Their report is said to have developed wide interest among both oil and automotive companies.

The general availability of a practical test method expressing "driver-feel" during the warm-up period would give refiners a technique for designing their motor fuels to fit engine requirements more closely. It would also permit the engine designers to develop engines more insensitive to fuel volatility. It has long been held by refiners that fuel systems too sensitive to volatility have placed unnecessary restrictions on the distillation characteristics of motor fuels generally.

Based on the work to date but looking into the future, the Gulf Oil-Ethyl Corp. investigators concluded in their report: "A compromise between fuel volatility and engine performance which permits the utilization of fuels covering a wide range of volatility should result in gasoline which will cost less to produce, cost less to the consumer and be available in greater quantity."

The accompanying article was prepared from the paper entitled "A New Approach to the Evaluation of Fuel Volatility and Associated Engine Variables", by J. E. Taylor, assistant chief automotive engineer, Gulf Research & Development Co., and H. J. Gibson, research coordinator, Ethyl Corp., presented at the Summer Meeting, Society of Automotive Engineers, French Lick, Ind., June 6-11, 1948

The economic benefits which would immediately result to refiners were they able to market motor fuel gasolines with a wider volatility range are discussed as follows in the report to the SAE:

Octane-End Point Trend

"The increase in octane number of motor fuels which occurred during the years just prior to World War II was accompanied by an increase in volatility which tended to minimize engine warm-up problems. The refiner supplied lighter gasoline of higher octane number as the automotive designer demanded it for his new cars. Simultaneously, this lighter fuel satisfied the increased volatility requirements of the older models brought on by deteriorating mechanical condition.

"Refining processes which were introduced prior to the war and expanded enormously during the war are now operating to reverse the pre-war trend in volatility. These new processes promise not only to reduce the volatility of motor gasolines, but also to cause a wider range of volatility.

"The reasoning supporting the above statement is illustrated in Fig. 1, which shows the ASTM octane number of gasoline components, made by various methods, as a function of the end point of the distillate. Thermally cracked and straight run distillates were the principal blending agents used for motor gasoline prior to the war. From the curves for these stocks it can be seen that reduction in end point was one means of increasing octane number. Since straight run-thermally cracked blends are the only stocks available to many refiners, it is likely that gasolines made from these materials will continue the pre-war trend toward increased volatility.

"On the other hand, also shown in Fig. 1, new refining methods such as catalytic cracking and polyforming produce distillates which are quite constant in octane number as end point is increased. With stocks such as these available there is no necessity to reduce end point to obtain octane number. Rather, there is every incentive to go to higher end points to utilize these high octane number fractions. The choice of whether these high boiling materials will be used in regular or premium gasolines will undoubtedly depend on the individual refiner's operations. However, in the past, premium fuels have generally been more volatile than the regular fuels, and there is no reason to believe this trend will be reversed, since better warm-up is considered to be one of the attributes of a premium fuel.

"It is possible to maintain high volatility in premium fuels without loss in total output of a refinery or additional refining expense, providing the high octane number, heavy gasoline fractions are used in regular fuels. However, the resultant regular gasolines would have quite low volatility. If it should be desirable or necessary to market high volatility gasolines for both grades of fuels to satisfy engine requirements, the possible effect on refinery economics of varying the 90% point of the gasoline may be shown by considering a hypothetical modern refinery. The range

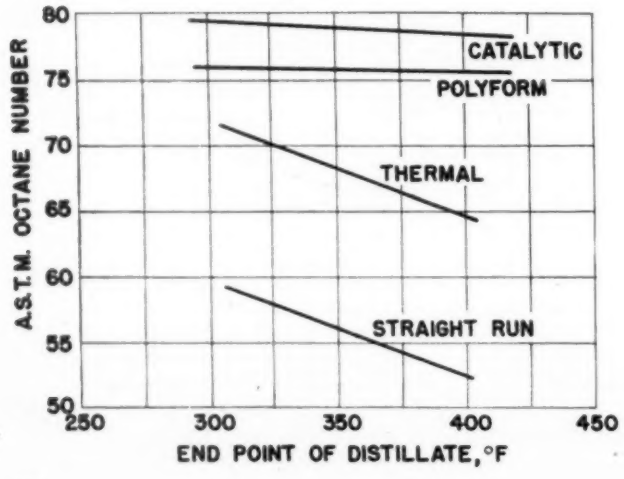


Fig. 1—Variation of unleaded octane number with end-point for gasoline components produced by several refining methods

in 90% point considered is approximately equal to that found in present day commercial gasolines.

"It is assumed that this refinery charges 50,000 b/d of Mid-Continent crude and operates for maximum gasoline production. In addition to straight run gasoline, the refinery produces cracked gasolines by catalytic cracking (re-cycle operation) of the distillate part of the crude oil boiling above 650° F. and polyforming the low octane straight run gasoline (approximate boiling range 240 to 420° F.) and the light oil product from the catalytic cracking operation (approximate boiling range 430 to 650° F.). Table 1 shows the effect of gasoline volatility on the total gasoline production of this hypothetical refinery.

"A decrease in 90% point of the gasoline from 365 to 300° F. with the heavy gasoline reprocessed in added equipment, results in a loss of 3000 b/d of gasoline, which is about 9% of the total plant production. In this example, most of the gasoline loss appears as fuel oil and fuel gas by-products and, since these materials have a value of about 4c per gal. less than gasoline, the loss in revenue to the refinery amounts to about $5000 per day, or nearly $2,000,000 per year.

"In addition to this loss in revenue, the refiner must install additional cracking capacity, at a cost of $1,000,000 to $2,000,000, to process the heavy gasoline fraction removed to reduce the 90% point from 365 to 300° F. If the refiner is unable or unwilling to install this additional cracking capacity, the loss in gasoline production becomes 5000 barrels per day, or 14% of the total plant production, and the loss in revenue increases proportionately.

TABLE 1—Effect of Gasoline Volatility on the Total Gasoline Production of a Hypothetical Refinery

	Low Volatility Operation	High Volatility Operation
90% Point of Gasoline, deg. F.	365	300
Research Octane Number, clear	83	83
Gasoline Product, B/D	35,000	32,000
Gasoline Loss		
1- barrels/day		3,000
2-% of low volatility operation		9
Loss in Refinery Revenue, $/D		5,000

"These figures illustrate the effect of volatility on a refinery charging less than 1% of the nation's daily crude run. This analysis indicates that gasoline of 300° F. 90% point would be more costly to produce, cost more to the consumer, and would be available in smaller quantities. It is also quite possible that the elimination of the high boiling, high octane components from premium gasolines would materially reduce the amount of high octane number (93 Research or higher) gasoline that can be made. While this analysis represents an extreme range in 90% point (365 to 300° F.), a study at any level will result in a proportionate loss in yield and revenue."

The new test procedure developed in the Gulf laboratories is described as an attempt to express "driver-feel" during the warm-up period on a sound technical basis. Briefly, the procedure consists of running the car at 20 mph., road load, and measuring its performance at the end of each minute of operation until it is fully warmed-up. The measure of car performance is based on the speed attained at the end of 6 seconds of full-throttle operation, starting at 20 mph. This procedure has proved to be quite reproducible, and sufficiently sensitive, to study the effects of variations in fuel or engine characteristics on warm-up performance. Test results are given as plots of change in speed during acceleration versus elapsed time. Fig. 2 is a typical warm-up curve on a single fuel, showing an actual decrease in speed of 5½ miles per hour after the throttle had been opened wide for six seconds at the end of the first minute.

An outline of the warm-up test cycle is given below, the fuel system containing test fuel and the engine and component parts being at ambient temperature prior to Step 1;

1—Start the engine and bring the car speed to 20 mph., road load, as quickly as possible, accelerating normally through the gears. On cars with a manual choke, the choke is placed in full-off position as soon as firing is regular.

2—Operate the car at 20 mph., road load, in high gear for the remainder of one minute after starting.

3—At the end of the first minute, accelerate the car at full throttle for 6 seconds and record the speed attained at the end of the acceleration. If the car has a manual choke, the

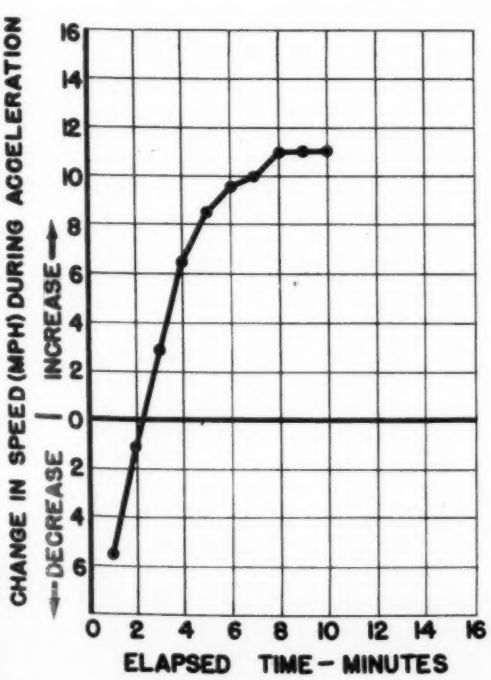
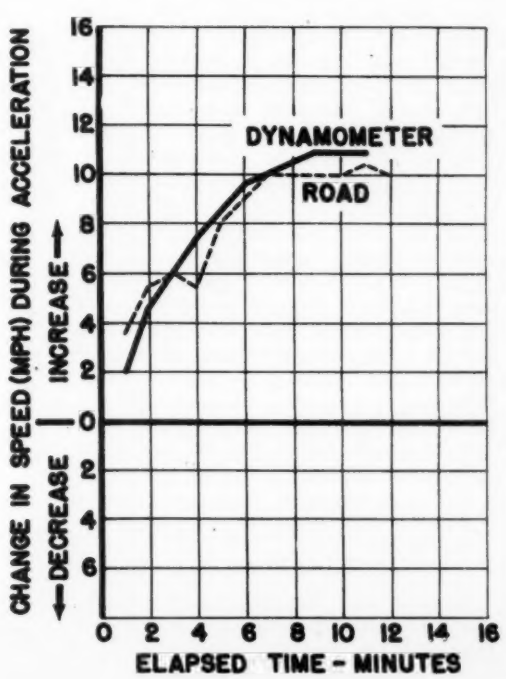


Fig. 2 (Left)—A typical warm-up curve. The ordinate "change in speed during acceleration" is based on the speed attained at the end of 6 seconds of full-throttle operation, starting at 20 mph, road load

Fig. 3 (Right)—Comparison of road and chassis dynamometer warm-up curves



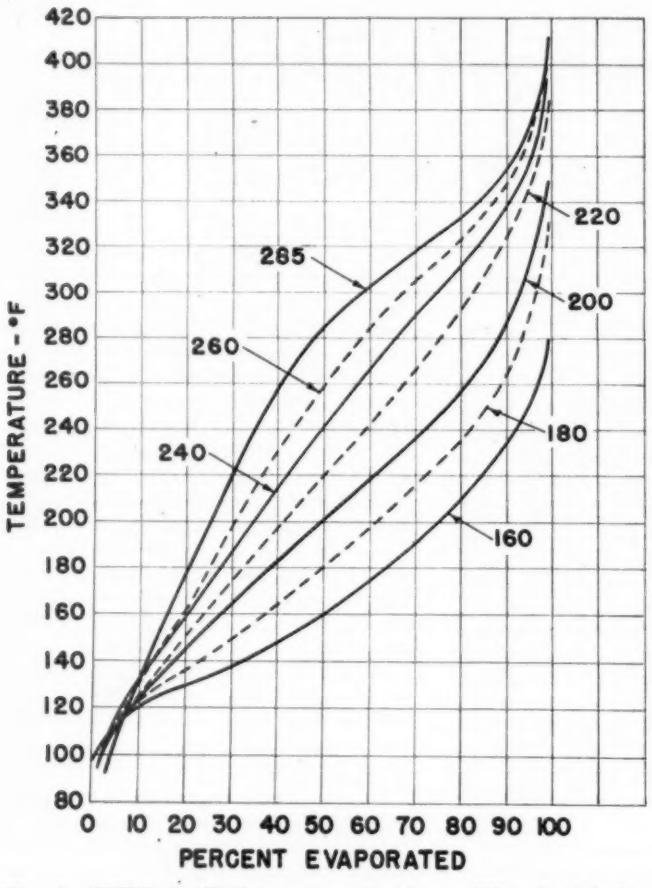


Fig. 4—ASTM distillation curves for the voltility test fuels. The figures referred to the individual curves designate the 50% evaporated temperature

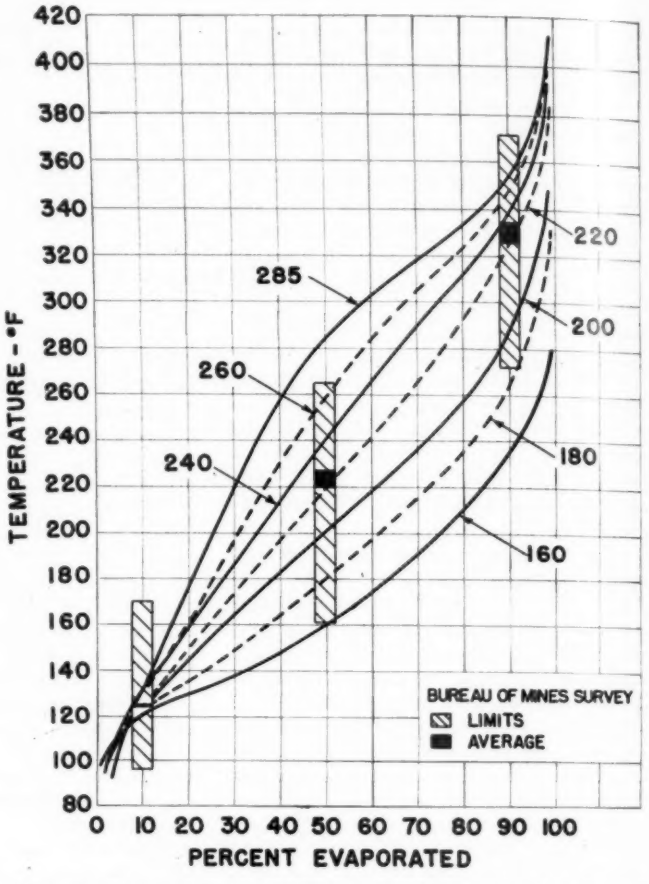


Fig. 6—Comparison of ASTM distillation curves for the volatility test fuels with the 10, 50 and 90% points of commerical gasolines available in the U. S. in the winter of 1946-1947

acceleration is made with the choke completely off.

4—Return the car to 20 mph., road load, and continue at this load and speed until a second minute has elapsed, then repeat the 6-sec. acceleration.

5—Repeat this cycle until three successive accelerations give the same final speed, indicating fully warmed-up performance.

6—Drain the test fuel, flush the fuel system with the next fuel and run for a period long enough to insure a complete fuel change.

The test procedure is particularly suited to use on a chassis dynamometer in a cold room. The dynamometers were equipped with inertia and fan loading devices and closely reproduced road acceleration. Work on the road indicated that reasonably satisfactory data can be obtained. However, variations in atmospheric temperature, grade, wind velocity and direction and traffic congestion make such work relatively inaccurate. Fig. 3 is a comparison of road and chassis dynamometer warm-up curves.

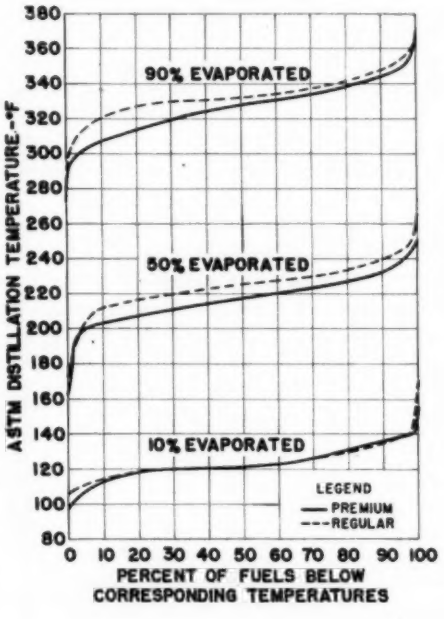
Test Fuels

In selecting fuels for the warm-up test program, it was recognized (1) that the Reid vapor pressure and front end volatility of all fuels tested should be substantially the same, so that their starting ability would be approximately equal, and (2) that the fuels should be as uniformly separated as possible over the remainder of the distillation range, since the relative effect of different parts of the distillation curve was not accurately known. The section of the paper on this subject follows:

"To meet these requirements, a series of seven test fuels was developed with distillation curves as shown in Fig. 4. The figures referred to the individual curves designate the 50% evaporated temperatures of the fuels. It will be noted that all fuels were different from their 10% points to end points and that the 50% points varied from 160 to 285° F. in approximately 20-degree steps. Each of these fuels was pressured with butane to 9.5 psi RVP. Since the 50% point is a good index of the over-all volatility of these fuels and is a convenient value to present, it is used throughout as an identifying number.

"Fig. 5 presents data obtained from the Bureau of Mines Survey of commercial gasolines for the winter of 1946-47. In this figure, the 10, 50, and 90% evaporated temperature limits of the commercial gasolines available in the U. S. are presented in such a manner that the importance of extreme fuels in the motor fuel

Fig. 5 (Below)—Distribution of the 10, 50 and 90% points of commercial gasolines available in the U. S. during the winter of 1946-1947



volatility picture can be readily evaluated.

"For example, the 50% evaporated temperatures of premium grade gasolines ranged from 161 to 250° F., a spread of 89° F. If it is agreed, however, that the least and most volatile 2.5% of these gasolines can be disregarded since they will seldom be encountered in service, this spread is cut almost in half to 47° F., the range being from 195 to 242° F.

"Fig. 6 again shows the distillation curves for the volatility test fuels, but in this case, the extreme 10, 50 and 90% evaporated temperatures of commercial gasolines are superimposed as vertical bars. The solid blocks, located inside the vertical bars, represent the average 10, 50, and 90% temperatures, with the upper and lower edges showing values for regular and premium grades, respectively. From this chart it can be observed that the test fuels bracketed the range of commercial gasolines quite well except at the 10% point where they were intentionally held close together, as previously mentioned. The blocks fall on the curve for the 220° F. 50% point test fuel which means that this was a good average fuel.

"The results obtained in one car when operated on all of the test fuels are shown in Fig. 7. The fuels cover the entire range from excellent to completely unsatisfactory warm-up performance. The 160° F. fuel reached fully warmed-up performance at the end of four minutes and gave smooth accelerations throughout the test cycle. The 180 and 200° F. fuels required a few minutes longer to reach fully warmed-up performance and were significantly poorer than the 160° F. fuel during the first few minutes. As volatility was further decreased the acceleration ability at any given time became progressively worse. A sharp decrease in fully warmed-up performance occurred with the 260° F. fuel, while operation on the 285° F. fuel was never satisfactory.

"It would be well to point out that smooth acceleration was not obtained at the end of the first minute on any but the 160° F. fuel, and ragged operation and bucking were encountered during every acceleration on the 285° F. fuel. In general, extreme raggedness of the warm-up curves indicates poor engine operation. Smooth performance was obtained in the car of Fig. 7, whenever it was sufficiently warmed-up to permit an increase in speed of at least 9 mph. during acceleration.

"Throughout this program, the smoothness of operation of any car during acceleration was related to the speed attained at the end of the acceleration period. As a general rule, smooth full throttle acceleration was obtained whenever a car produced an increase in speed which was equal to 80% of the increase obtained under fully warmed-up conditions with a volatile fuel such as the 180° F., 50% point test fuel."

Recognizing that the value of the warm-up test procedure depended on its correlation with customer reaction, arrangements were made in the test program to determine customer reaction to fuel volatility in normal daily driving. Two or more of the test fuels were rated by the drivers of 14 selected cars, few of whom knew that warm-up performance was being studied. The fuels, were high enough in octane rating to exceed the requirement of the test vehicle, so that the driver's impressions of the fuels could be influenced by volatility only.

It was noted that the drivers rated the fuels in the proper order according to their 50% evaporated temperature. From this it was concluded that fuel volatility is a characteristic readily evaluated by the customer; also that the test procedure adopted placed fuels in the same relative order as does the customer, except that it does not evaluate the possible undesirable reaction to extremely volatile fuels.

Car Characteristics

During the investigation warm-up tests were conducted on at least one of each make of postwar car sold in appreciable volume, the cars being in good mechanical condition. Wide variation was found in the warm-up characteristics of different makes of cars.

In general it was found that cars which are most sensitive to volatility are also most sensitive to changes in temperature.

It was expected that engine temperature data would help to explain the differences in warm-up performance exhibited by the various makes of cars. However, a careful analysis of temperatures determined during the work (hot spot, carburetor air, intake manifold branch and jacket water) did not substantiate this belief.

A number of engine and operating variables were investigated in relation to warm-up performance, such as manifold heat control, automatic choke adjustment, radiator covers, and manifold cleanliness, among others. It was found that manifold cleanliness and manifold heat were most important in their effect on warm-up.

The relative effects on warm-up of the 10, 50 and 90% points of the distillation curve were investigated briefly in the warm-up test program. It was concluded that, while further work is required to establish the relative significance of the 10, 50 and 90% points, it appears that the various parts of the distillation curve exert their primary influence during a particular part of the warm-up period.

The effect of the 10% point is relatively small and seems to be most pronounced during the initial warm-up. The 50% point appears to be of the greatest importance and the 90% point has little effect until the car is approaching fully warmed-up condition.

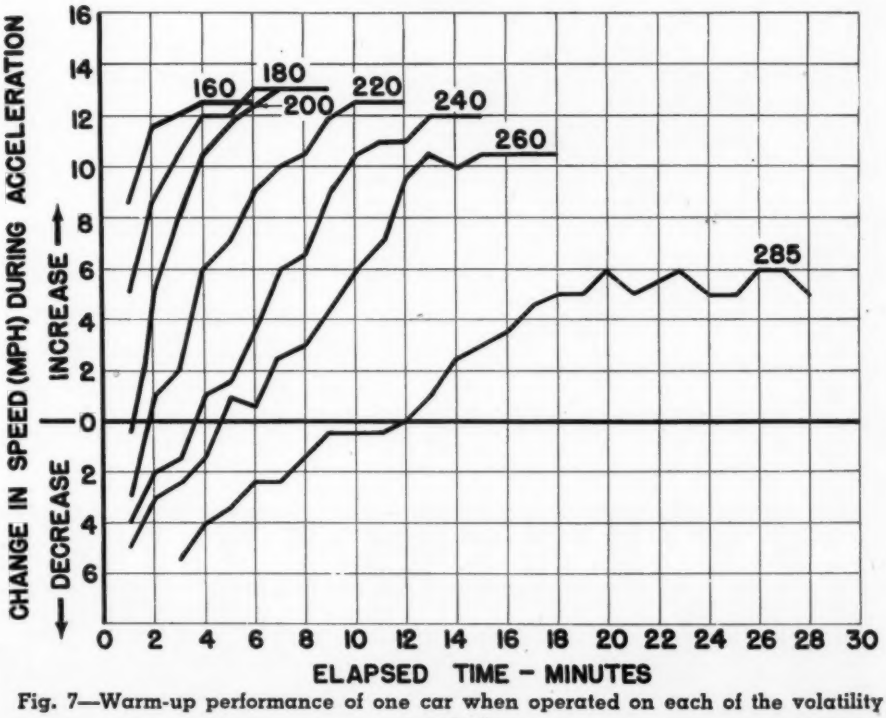


Fig. 7—Warm-up performance of one car when operated on each of the volatility test fuels

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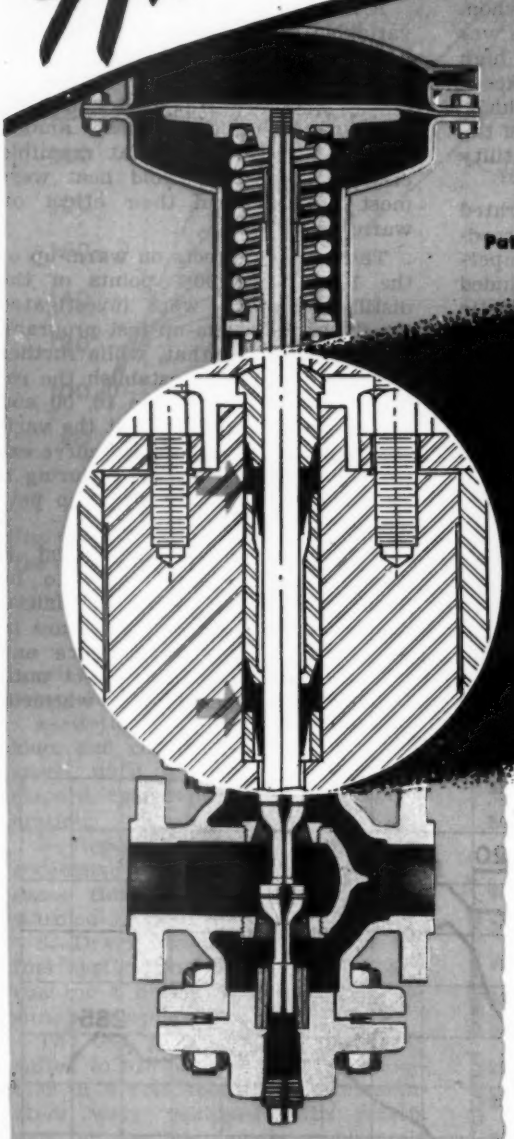

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Thermofor Pyrolytic Cracking

New Process Employs Moving Bed of Heated Pebbles For High Temperature Cracking of Hydrocarbon Feed Stocks; Produces High Yields of Ethylene, Aromatics

By S. C. EASTWOOD and A. E. POTAS,
Socony-Vacuum Laboratories, Paulsboro, N. J.

THE post war expansion of the chemical industry has created an unprecedented demand for ethylene and certain monocyclic and dicyclic aromatics. These chemicals are used in the manufacture of plastics, synthetic rubbers, insecticides and many other organic chemicals.

Ethylene is obtained predominantly by recovery from refinery cracked gas streams and by pyrolysis of propane and ethane. It is also produced to a limited extent by pyrolysis of liquid stocks, such as crude oils, in localities where light hydrocarbons are not readily available. In most parts of the country the price of propane is increasing to the point at which it cannot be cracked profitably to produce ethylene. Thus ethane and liquid feed stocks appear to be the chief source of charge stocks for future cracking installations.

Aromatics are obtained in about equal quantities from the coal tar and petroleum industries[1]. Coal tar aromatics are by-products of coke oven operations and are, therefore, limited by the extent of these operations. The aromatics from petroleum are obtained by super fractionation and azeotropic distillation of select straight run, cracked or hydroformed petroleum fractions.

The cracking of ethane or liquid feedstocks to produce high yields of ethylene requires extremely high temperatures, low pressures, and short contact times. Several methods have been employed in the past to carry out this type of cracking; i.e., the use of tubular, regenerative, or molten lead furnaces, and highly superheated steam. None of these methods, however, presents a satisfactory solution to the main processing problems inherent in this type of cracking; namely, efficient transfer of heat from the primary source to the material being cracked, rapid heating to high temperatures, freedom from fouling with coke, and simplicity of operation. To meet these problems a new process called "Thermofor Pyrolytic Cracking" has been developed in the Socony-Vacuum Laboratories at Paulsboro, N. J.

The TPC process is based on techniques and knowledge acquired in the development of the TCC process [2] and is similar to TCC in that hydrocarbon feed is contacted continuously with a moving bed of solids. The new process is covered by patents assigned to Socony-Vacuum Oil Co., Inc.

The TPC system comprises two main elements: a reactor and a heater. A bucket elevator is used to lift

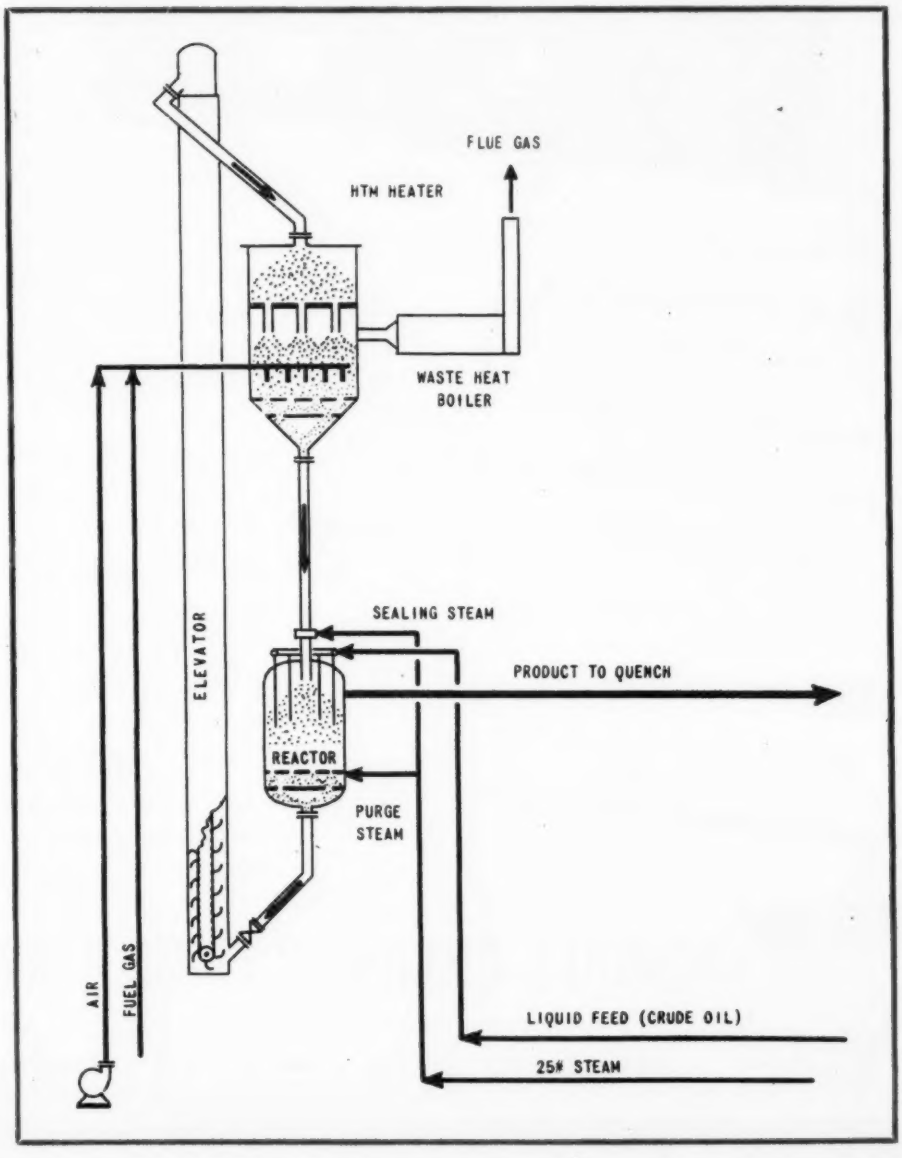
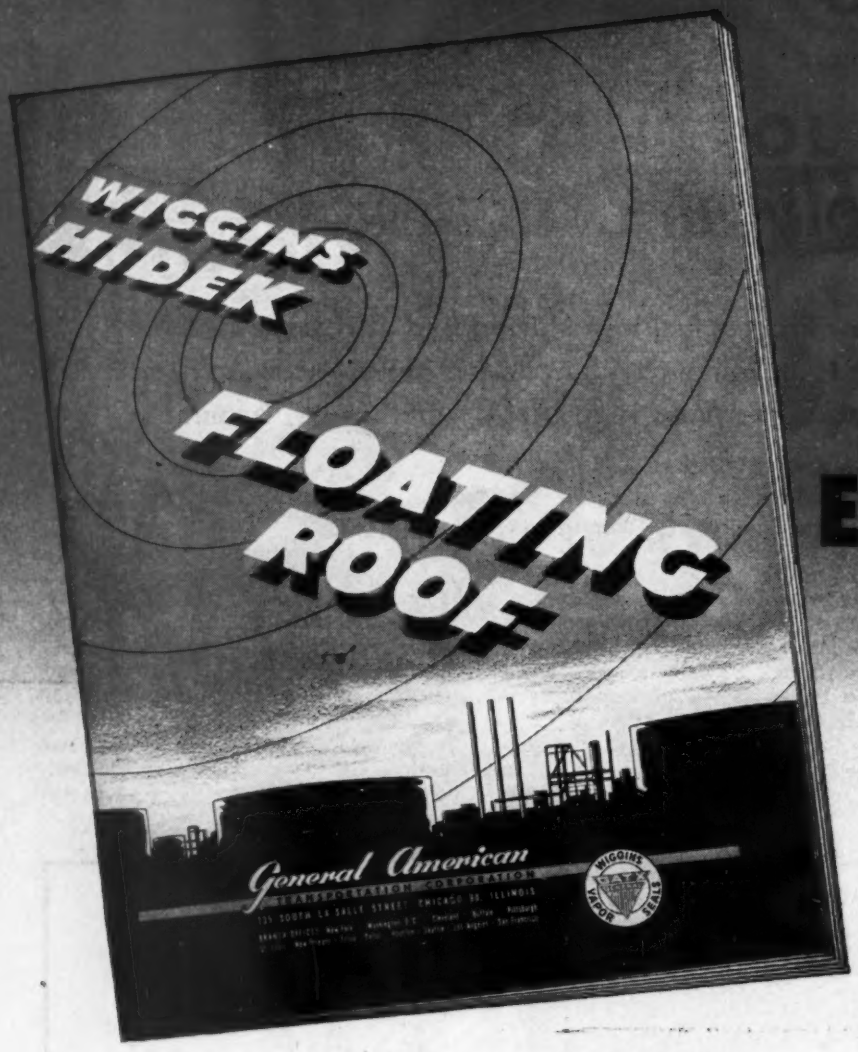


Fig. 1—Right, flow diagram of Socony-Vacuum's Thermofor Pyrolytic Cracking process for ethylene and aromatics production



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the pebbles to the top of the unit where they are discharged into the heater. The heater serves to preheat the pebbles to the desired temperature level by direct combustion of fuel gas in the pebble bed. Any coke deposited on the pebbles in the cracking step is burned off in this stage. The hot pebbles flow by gravity from the heater into the reactor where the heat stored in the pebbles is utilized to preheat and crack the hydrocarbon feed. The cooled pebbles from the reactor flow through a throttling valve, into the elevator which returns them to the top of the unit for re-use. A specially designed baffle system is used to prevent channeling of the pebble flow in both the reactor and heater. A diagrammatic sketch of the TPC system is shown in Fig. 1.

Pebbles satisfactory for use in this process are non-catalytic refractory materials of spherical shape 0.2 to 0.4 in. in diameter meeting the following requirements: (1) high density—for compact unit design, (2) high specific heat—to reduce the weight which must be circulated, (3) high resistance to wear, spalling and breaking—to minimize replacement rate, (4) low abrasion characteristics—to prevent excessive wear on vessels and (5) high softening temperatures. Several materials developed by refractory companies appear to meet all of the above requirements. This development work has involved extensive testing in Socony-Vacuum pilot plant equipment designed to simulate the most rigorous conditions likely to be encountered in commercial TPC plants.

One of the problems encountered in the development of the TPC process was to find an efficient means of preheating the pebbles. This led to the development of a heater employing direct combustion of air and gas in the pebble bed. A pilot plant heater representing a full scale section of a proposed commercial heater has been operated for several years. This heater is capable of heating about two tons per hour of pebbles from 1000 to 1600° F. It was found that by proper adjustment of all the variables involved, burning efficiencies approaching theoretical can be obtained with 0 to 5% excess air and with complete combustion to carbon dioxide and water. Externally fired heaters can be used but they are more expensive and less efficient.

The flow of hydrocarbons relative to pebbles through the reactor is countercurrent. The charge stock may be partially heated outside the reactor or may be introduced cold directly into the lower section of the reactor, where residual heat is available in the pebbles for preheating or vaporizing the feed. Extremely high rates of heat transfer, in the order of 15,000 Btu./hr./°F./cu. ft. of pebbles, are obtained in this type of reactor. Thus the charge stock is preheated to high temperatures very rapidly and undesirable cracking at low temperatures is minimized. The cracking temperature is controlled by the temperature of the pebbles entering the reactor and by the ratio of pebble circulation rate to hydrocarbon charge rate. The hydrocarbon contact time is controlled by the vapor rate through the reactor and the bed depth. The cracked vapors leaving the reactor are quenched immediately to prevent decomposition or polymerization of the ethylene.

The process has the advantage of being extremely flexible with respect to the type of charge stock processed. It can be designed to crack either gaseous or liquid feedstocks. Crude oils or reduced crudes can be handled just as easily as distillate stocks since any carbon formed on the pebbles during cracking is continuously removed from the reactor. Carbon deposited in this manner is an advantage with the TPC process since it lowers the external fuel requirements in the heating stage.

Pilot Plant Studies

Cracking studies have been made in a one-barrel-per-day pilot unit capable of operating at temperatures up to 1800° F. Charge stocks ranging from ethane to reduced crudes

TABLE 1—TPC Cracking of Light Hydrocarbons for Ethylene Production

Type of Operation	——Once-Through Cracking——			Recycle Cracking Mixed Light Hydrocarbons	
Charge Stock	Ethane		Propane	Fresh Feed	Recycle
Composition, %-wt.					
Methane + Hydrogen	....		....	0.8	....
Ethane	99+		....	40.8	63.4
Propane	....		99+	40.0	14.4
Propylene	....		....	16.0	22.2
C_4's	....		....	2.4	....
Total	....		....	100.0	100.0
Pebble Preheat Temperature, ° F.	1525	1770	1510	1500	
Contact Time, Secs.	2.3	0.12	1.2	1.7	
Recycle to Fresh Feed Ratio, wt.	....	....	....	1.0	
Yields, % wt. on Charge					
Hydrogen	5.7	5.7	2.0	3.2	
Methane	12.8	10.2	26.2	23.2	
Acetylene	0.7	3.8	0	0	
Ethylene	49.2	56.2	37.5	62.0	
Ethane	18.2	11.6	3.5	....	
Propylene	0.7	1.0	12.2	....	
Propane	1.1	0.7	7.9	....	
Butadiene	1.6	3.2	2.3	0	
Butylenes	1.8	0.4	1.1	3.0	
Butanes	1.0	0.3	0	2.0	
C_5+	6.7	6.1	6.8	5.0	
Coke	0.5	0.8	0.5	1.6	
Total	100.0	100.0	100.0	100.0	
Ethylene Concentration in C_2 and Lighter, Mol %	29.0	33.3	32.7	30.1	

TABLE 2—TPC Cracking of Liquid Feed Stocks for Ethylene Production

Charge Stock	Michigan Crude	East Texas Crude	Slaughter-Duggan Crude	Mirando Crude	Naphthenic Catalytic Light Cycle Stock
Properties					
Gravity, API	34.8	38.4	31.0	21.2	26.6
Aniline Point, F.	160	172	143	131	114
Sulfur, % wt.	0.39	0.33	2.30	0.24	0.28
Distillation, F.					
I.B.P.	223	148	150	240	412
10% Vol.	328	290	252	448	459
50% Vol.	572	595	585	620	510
90% Vol.	993	980@80%	902@75%	915	600
Pebble Preheat Temperature, ° F.	1550	1515	1500	1500	1515
Yields, % wt. on Charge(1)					
Hydrogen	0.9	0.7	0.7	0.7	0.6
Methane	14.8	14.1	15.3	13.0	10.8
Ethylene	28.8	22.3	17.9	12.5	11.7
Ethane	3.5	4.3	4.5	3.0	2.3
Total C_2 + Lighter	48.0	41.4	38.4	29.2	25.4
Propylene	6.4	12.2	8.0	6.8	6.5
Propane	0.7	0.7	0.6	0.6	1.0
Butadiene	2.5	3.1	1.0	1.6	1.0
Butylenes	1.4	3.0	1.7	2.9	3.0
Butanes	0.9	0.6	1.2	0.2	2.7
Total C_5's	1.0	0.7	1.4	1.8	3.6
Total C_3's to C_5's	12.9	20.3	13.9	13.9	17.8
				29.6	24.7
C_6 to 500° F. Liquid	36.4	36.5	44.1	29.6	24.7
500 F + Liquid				25.6	30.5
Coke	2.7	1.8	3.6	1.7	1.6
Total	100.0	100.0	100.0	100.0	100.0
Ethylene Concentration in C_2 and Lighter, Mol %	40.9	36.7	30.5	26.1	28.4

(1) The light hydrocarbon distribution does not include H_2S. In the above operations on sweet stocks the H_2S produced is small (0.1% wt on charge); however, on the Slaughter-Duggan crude, the H_2S is estimated to be 1.0% wt of charge.

have been evaluated for ethylene and aromatics production. The preferred operating conditions for ethylene production vary with the charge stock but generally fall within the following range:

Pebble to hydrocarbon feed ratio, wt.	10-20
Pebble preheat temperature, °F.	1400-1800
Hydrocarbon contact time, secs.	0.1-2.5
Pressure, psig.	0-5
Steam, %-wt. of charge	0-50

Of the various charge stocks evaluated, ethane gives the highest yield, propane the next highest, while the lowest yields are obtained from aromatic and naphthenic type liquid charge stocks.

Ethylene Yields From C_2 and C_3

Typical ethylene yields for TPC cracking of ethane, propane and ethane-propane-propylene mixtures are shown in Table 1. Once-through cracking of ethane with a pebble temperature of 1525° F. and a contact time of 2.3 secs. gives an ethylene yield of 49.2%-wt. Recycling the unconverted ethane would give an ultimate ethylene yield of 60.1 at a recycle ratio of 0.22 parts recycle to 1.00 part fresh feed. Increasing the cracking temperature and decreasing contact time raises the once-through ethylene yield. For example, at a 1770° F. pebble temperature and 0.12 secs. contact time, the once-through ethylene yield is increased to 56.2%-wt. At this temperature the yield of acetylene becomes appreciable, being 3.8%-wt. of charge. An ultimate ethylene yield of 63.6%-wt. would be obtained at a recycle ratio of 0.13 parts recycle to 1.00 part fresh feed.

Once-through cracking of propane with a pebble temperature of 1510° F. and a contact time of 1.2 secs. gives an ethylene yield of 37.5%-wt. About the same conversion of propane and ethane are obtained at 1510-1525° F. for the operations described above but ethane requires double the contact time compared to propane.

Several C_2-C_3 gas mixtures, typical of feedstocks which can be recovered from refinery cracked gas streams, have been evaluated. An ultimate ethylene yield of 62.0%-wt. was obtained from a mixture comprising 40.8%-wt. ethane, 40.0%-wt. propane, and 16.0%-wt. propylene at a pebble temperature of 1500° F., a contact time of 1.7 secs., and a recycle ratio of 1.00 part recycle to 1.00 part fresh feed.

Ethylene from Liquid Charges

Typical ethylene yields for TPC cracking of several liquid charge stocks are shown in Table 2. The ethylene yields range from 28%-wt. of charge from the most paraffinic stock to 11.7%-wt. from the most naphthenic stock. As in the case of ethane, the ethylene yield can be increased from these stocks to a certain degree by increasing the pebble temperature and decreasing contact time.

The yields of other olefins, such as propylene, butylenes and butadiene, can be increased by decreasing the cracking temperature or contact time. Adjusting the operating conditions to increase the yields of these higher molecular weight olefins, however, generally results in a loss in ethylene yield.

Ethylene and Aromatics

The TPC cracking of liquid charge stocks to produce ethylene gives a fraction boiling between 150 and 500° F., containing 40 to 75%-wt. aromatics. The concentration of aromatics in this liquid fraction can be increased to 90-95% by increasing the contact time of the cracking reaction several fold. Although increasing the contact time through this range does not change the ethylene yield appreciably it does decrease the ethylene concentration in the C_2 and lighter gas, making the recovery of ethylene more costly. This, however, is not a serious factor where both ethylene and aromatics are desired. Typical aromatic yields from several charge stocks are shown in Table 3. It will be noted that aromatic and naphthenic stocks give the highest yield of aromatics and that the ratio of monocyclic to dicyclic aromatics can be controlled to a considerable extent by choice in boiling range of the charge stock. Since the chief impurities in the aromatic fraction are olefins, high purity aromatics can be prepared by acid treating to remove olefins, neutralizing, washing, and distilling.

TABLE 3—Aromatic Distribution Obtained by TPC Cracking of Liquid Feed Stocks

Charge Stock	Mirando Crude	East Texas Crude	Naphthenic Catalytic Light Cycle Stock	Paraffinic Catalytic Light Cycle Stock	Virgin Coastal Naphtha
Aromatic Yields, % wt.					
Benzene	7.7	7.8	5.9	5.9	12.4
Toluene	5.8	3.6	3.7	3.2	8.2
Xylenes	1.9	1.2	0.9	0.9	2.3
Styrene	0.1	0.2	0.2	0.1	0.3
Other C_8 Aromatics	0.6	0.5	0.5	0.3	0.3
C_9 + C_{10} Aromatics	1.2	1.0	0.8	0.5	1.4
Naphthalene	3.9	2.2	3.4	4.3	3.2
1-Methyl Naphthalene	2.1	1.0	2.6	3.7	1.1
2-Methyl Napthalene	1.5	0.8	1.2	1.5	0.7
Total	24.8	18.3	19.2	20.4	29.9
Liquid boiling above 2-Methyl Naphthalene	28.4	20.0	31.8	33.5	15.9
Aromatic Concentration in C_8 to 2-Me-Naph. Fraction, %-Vol.	94.0	90.5	93.0	95.8	90.2
Ratio Mono-cyclic to Di-cyclic Aromatics	2.30	3.57	1.67	1.14	4.98
Ethylene, % wt.	12.5	21.6	15.7	16.6	15.0
Total Aromatics + Ethylene, % wt.	37.3	39.9	34.9	37.0	44.9
Ethylene Concentration in C_2 + Lighter, Mol-%	21.7	31.9	24.4	29.0	21.7

TABLE 4—Principal Products for a Typical Commercial TPC Project

(100% Recovery Basis)

Charge Stock	2400 b/d East Texas Crude
Products	
Ethylene, lbs/yr	50,000,000
Propylene, lbs/yr	20,300,000
Butadiene, lbs/yr	3,200,000
Benzene, gals/yr	2,440,000
Toluene, gals/yr	1,130,000
Xylenes, gals/yr	400,000
C_8—C_{10} Aromatics, gals/yr	530,000
Naphthalene, lbs/yr	5,100,000
Methyl-Naphthalenes, lbs/yr	4,200,000
Higher Boiling Liquid, gals/yr	4,720,000

Several chemical companies are actively considering the installation of TPC facilities to manufacture ethylene and aromatics. One of the projects involves the cracking of 2400 b/d of East Texas crude to produce 50,000,000 lbs. per year of ethylene. The quantities of other major chemical products from such an operation are shown in Table 4.

Summary

A new process, Thermofor Pyrolytic Cracking, has been developed for high temperature, low pressure cracking to produce ethylene and aromatics. This process has the following advantages over other high temperature cracking operations:

1) Wide flexibility with respect to charge stock.

2) Efficient transfer of heat from the primary source to the hydrocarbon being cracked.

3) Rapid heating of the hydrocarbon charge to high cracking temperatures.

4) Continous elimination of any coke formed in the reactor during cracking.

5) Ability to introduce charge stock into the reactor without preheat.

The TPC process can be licensed from Socony-Vacuum through contractors such as the Vulcan Copper and Supply Co. and the Rust Engineering Co.

References

(1) Synthetic Organic Chemicals, United States Production and Sales—*United States Tariff Commission Yearly Reports.*

(2) The Thermofor Catalytic Cracking Process; T. P. Simpson, L. P. Evans, C. V. Hornberg, and J. W. Payne; *Proc. API.* 23 (3) 59, 1942; also *National Petroleum News, Technical Section,* 34 (47) R-427, Nov. 25, 1942.

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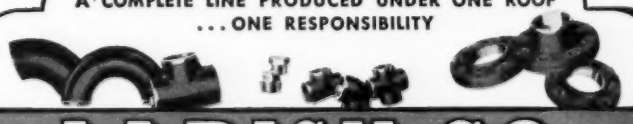

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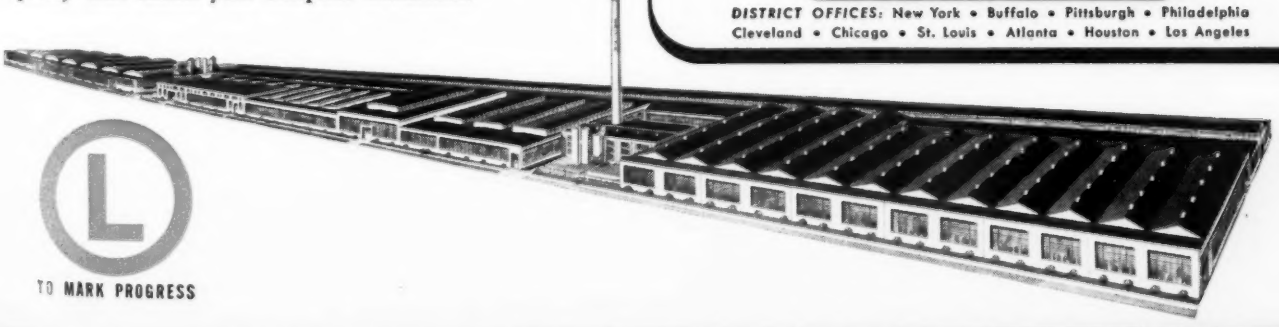

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Solidification Temperature, ° F	—20

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Specific Gravity at 60°/60° F.	0.91
Pounds per Gallon at 60° F	7.57
Flash Point (Tag C.C.) ° F	60
Viscosity at 100° F., S.U.S.	41
Solidification Temperature, ° F	0

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Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

The "K" value, ratio of specific heats, is used for calculating horsepower requirements for gas compressors. How is it determined in the case of vapor mixtures containing hydrogen and other gases in addition to hydrocarbons?

Our method of determining the "K" value (sometimes called "N" value) for mixed gases is as follows:

From any text on thermodynamics and for a unit weight of gas, we find the equations:

$$PV=RT \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$C_v=C_p-\frac{R}{778} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where:

P=pressure in lbs./sq. ft.,
V=volume of gas, cu. ft.,
T=absolute temperature, °Rankine (°F+460),
C_v=specific heat at constant volume,
C_p=specific heat at constant pressure,
R=gas constant for unit weight of gas.

In the molar system, and using temperature in degrees Fahrenheit absolute, and at atmospheric (sea level) pressure:

P=14.7×144
V=379.5 (volume of one mol. of any gas at 14.7 psia. and 60° F.)
T=60+460
=520

So that, from Equation 1:

$$14.7\times144\times379.5=R\times520$$
$$R=1544.808$$

Then, from Equation 2:

$$C_v=C_p-\frac{1544.808}{778}$$
$$=C_p-1.986 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

and

$$K=\frac{C_p}{C_v}=\frac{C_p}{C_p-1.986} \quad \ldots\ldots\ldots\ldots (4)$$

In a gas mixture, if the C_p per mol. of each is multiplied by the mol-% in the mixture, and the products added, the total will represent the C_p per mol. of the entire gas mixture.

The method applies irrespectively of the kinds of gases, hydrocarbons or others, in the mixture. The basic theory behind this procedure is as follows:

A mixed gas is made up of various components, each with a definite weight which is proportional to the percent by volume of the component in the mixture and to the component's own weight per unit volume. If we find the weight of each component in the mixture and multiply this by the specific heat per pound of that substance, the result is the number of Btu. required to increase the temperature of that amount of substance 1° F. And so on, for each component. In our procedure, we use percentages instead of actual weights. A good source of information on C_p values and the like is the Coordinated Projects 44 and 45 of the American Petroleum Institute and the National Bureau of Standards.

Our procedure gives us the K value of the mixed gas at atmospheric pressure and temperature. We appreciate that the K value will change somewhat with pressure and temperature. However, the change is so slight—within the normal range of pressures and temperatures encountered in usual compressor work—that little discrepancy results in using K values so found. Volume changes at inlet conditions, due to compressibility, must be compensated for but we feel that such correction should be made independently rather than by modification of K value, as has been suggested by some writers.—H. M. Boteler, Compressor Division, Worthington Pump & Machinery Corp., Buffalo.

Data in answer to questions presented on these pages is supplied through the cooperation of authorities with the equipment and engineering companies of the Natural Gasoline Supply Mens Assn., among others. Readers are invited to submit queries on plant operating problems in their own work.

What is the difference between cross-flow and counterflow cooling towers and how are these flows achieved?

The accompanying diagrammatic sketches show the arrangement of several types of induced draft water-cooling towers. In each sketch the solid arrow represents the path of the water flow and the wavy arrow the ambient air flowing through the tower. Also, "L" represents the louvers between which the air enters the tower, "F" is the induced draft fan located at the air exit, "A" is the wood-slat filling, and "E" is the wood-slat eliminator used to prevent moisture drift-loss from the tower.

Counterflow towers, Fig. 1, have a water distribution system that is inaccessibly located under the tower decking between the drift eliminator and the wood filling. Inspection, adjustment or cleaning requires shutting down and removing parts from the tower; at best this is an inconvenient, costly, and hazardous task. The cross-flow design, Fig. 2, uses an open water-distribution system on the top of the tower and offers ready accessibility, inspection, accurate regulation of water flow, and ease of cleaning. The counterflow tower admits a high-velocity stream of air through a small louvered area near the bottom of the tower, this air must then turn and travel upward. Dead air pockets and short circuits of air are likely to occur and less efficient water cooling results. Cross-flow towers induce air through their

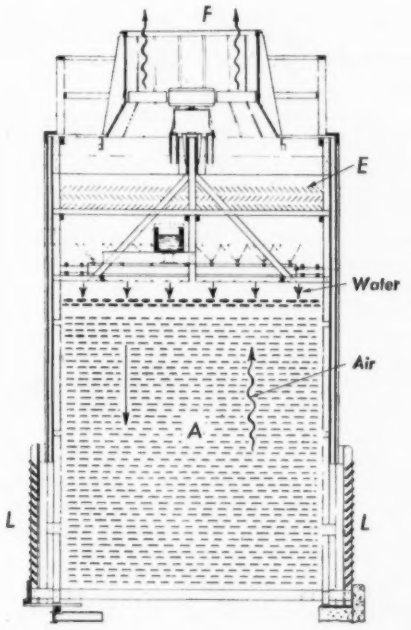

Fig. 1—Sketch of counterflow water cooling tower. Solid arrow is water flow; wavy, air flow. "L" represents louvers, "F" is the fan, "A" the filling and "E", drift-eliminator

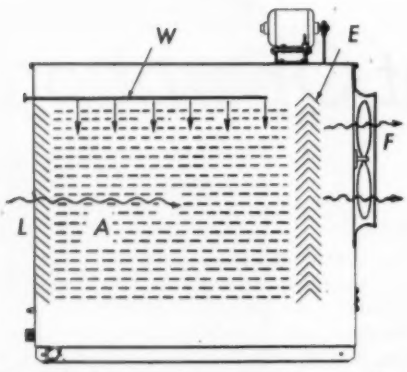

Fig. 2—Diagram of a cross-flow cooling tower; symbols are same as in Fig. 1

entire height along the sides and then across the filling through the fan exit. Since air is induced evenly across the filling, there is no chance for inactive air spaces or short circuits. The drops of water meet a steady flow of air as the water cascades downward through the filling.

To meet increased capacities counterflow towers are made wider and the inactive air spaces become progressively greater. In large installations counterflow tower units may be placed back-to-back as well as side-by-side; this arrangement requires double mechanical and electrical equipment to purchase, operate, and maintain. In the double-flow tower, Fig. 3, a fan operates over the dual plenum chamber, this central area providing increased eliminator space without changing the air flow across the active tower (heat transfer) area. As larger towers are required, this design would provide larger fans rather than more fans.

Because of the design features of counterflow towers, the interior of the tower must be encased. For proper air travel the wood filling and distribution system must be completely enclosed; thus inspection and maintenance require shutting down the tower and partial disassembly for access. On the other hand, practically every component of the cross-flow and double-flow tower may be seen, inspected and cleaned without rendering the tower inoperative or removing parts. Atop the tower it is possible to observe the mechanical equipment and the water distribution system. The filling may be inspected or cleaned from the outside through the louvered side walls.

The maximum drift eliminator area possible in counterflow towers equals the top plan area. Some towers use less eliminator area when the distribution system (flume type) and eliminators are built integrally on the same level.

In some designs of counterflow towers the water is sprayed to start immediate diffusion, this adds to the head required to pump the water to the spray system. If the water were not sprayed, then the upper third of the tower filling would be used as diffusion decks with a "semi-flooded" water condition and that part of the tower would be lost for effective cooling of the water. On the cross-flow tower no pressure is needed to spray the water from the open distribution basin atop the tower. Closely spaced water-diffusion decks are located directly beneath the water supply basin and out of the path of the heated air as the latter approaches the fan. In this design the water is evenly distributed and finely divided before it reaches the wood-fill surfaces for cooling.

Water is cooled primarily from the wetted wood surfaces and secondarily from the water droplets to the moving air. Since water travels downward and air upward in a counterflow tower, wood slats broadside to the air flow result in excessive draft losses if closely spaced. Where the slat is set on edge, air-water time contact is greatly decreased as the water cascades toward the collecting basin. In the cross-flow tower the filling is arranged in horizontal decks which provide greater air-water time contact and less draft loss through the active tower area. —Ray T. Jenkins and Howard E. Degler, The Marley Co., Inc., Kansas City.

When several new natural gasoline plants must be staffed completely and quickly, what is the best plan for setting up a job training program?

We have under way, at five of Stanolind's natural gasoline and cycling plants, a job training program to provide a pool of experienced employes from which may be drawn the personnel for newly constructed plants. This program provides instruction and training for all gasoline plant personnel. Supervisory employes receive training and gain experience by organizing and conducting discussion sessions relative to plant operations. Hourly rate employes learn their jobs through participation in these discussion sessions and on-the-job training.

At the beginning of the program each employe receives a job-training manual. The manual is in loose-leaf form and contains, besides the text, illustrations of the major pieces of equipment common to all natural gasoline plants. The manual also provides a description of the physical process at any particular plant and illustrates the process with diagrams, flow sheets, charts and report forms.

The trainees, divided into groups on the basis of experience, attend weekly discussion sessions which last from two to three hours. These sessions are held during regular working hours for non-operating personnel and outside regular working hours for operating personnel. The time spent attending these sessions is considered as time worked, and attendance is strictly voluntary.

Upon completion of the discussion sessions, on-the-job training is initiated. Such training is provided for the job classifications of Engineer Helper, Second Class Engineer, and First Class Engineer. The training cycle begins with the assignment of a Roustabout as observer of the Engineer Helper. When the Roustabout is fully acquainted with the work at this level, he becomes an apprentice and has full responsibility for the job of Engineer Helper. The Engineer Helper, in turn, is assigned as observer of the Second Class Engineer. A training cycle ends when the Second Class Engineer has completed his apprenticeship as First Class Engineer.

The discussion session period of the job-training program requires from 16 to 24 weeks; the on-the-job training period requires from 10 to 12 weeks. The whole program, therefore, is completed within 26 to 36 weeks.—R. A. Carter, Stanolind Oil & Gas Co., Tulsa.

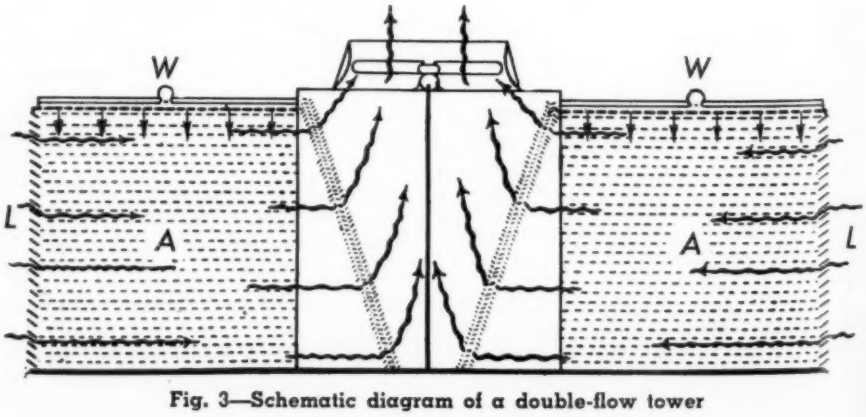

Fig. 3—Schematic diagram of a double-flow tower

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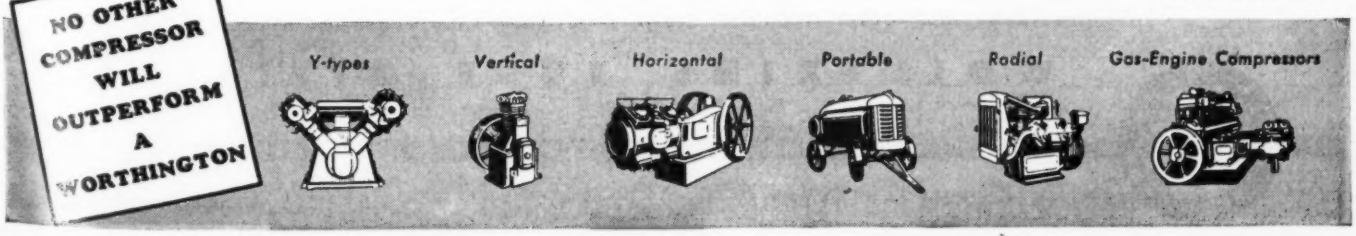

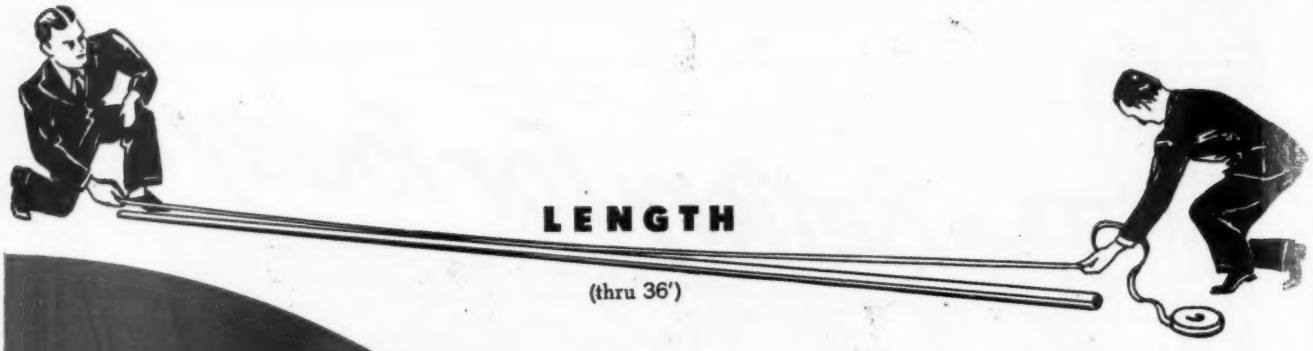

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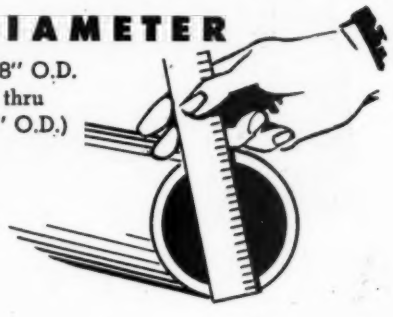

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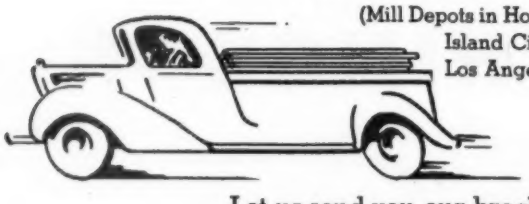

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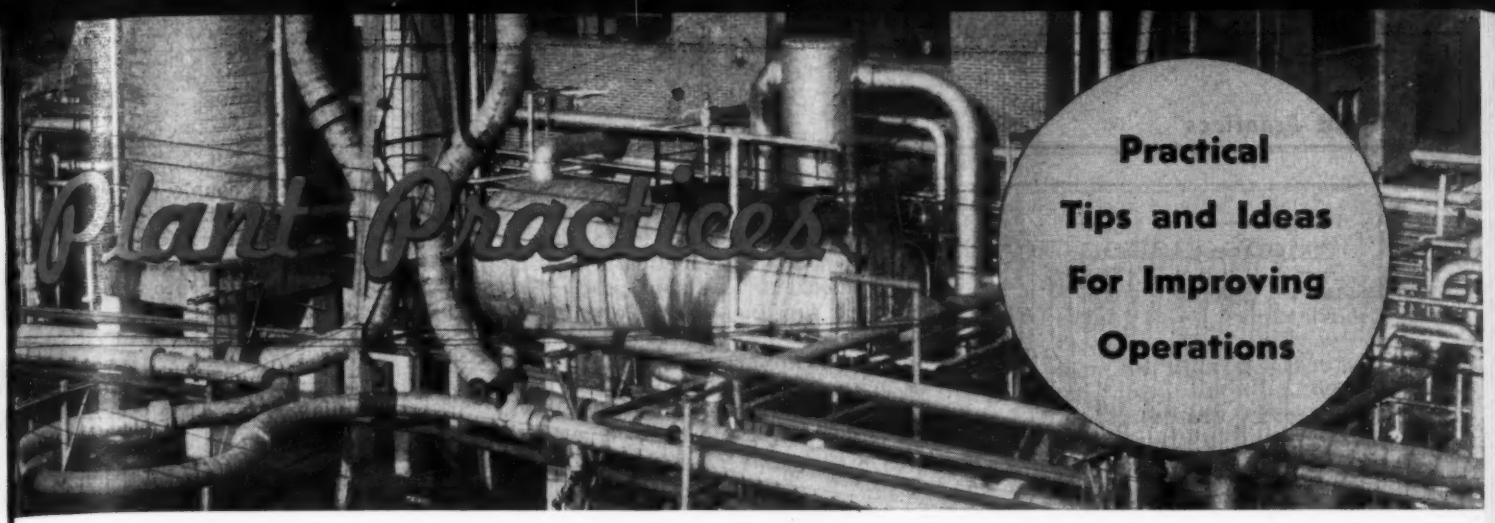


Weld Repairs on Tubing Stress-relieved With Water-cooled Copper Induction Coils

By E. K. DEWEY, Jr., Metallurgist
Mfg. Dept., Continental Oil Co., Ponca City, Okla.

SALVAGING furnace tubes by welding on appropriate lengths salvaged from other tubes is becoming common practice in some refineries. However, it is necessary to stress-relieve the weld, especially where alloy tubing is involved, and therein lies much of the difficulty in securing usable tubes with satisfactory service life.

Stress-relieving generally is achieved by (1) using a small clamp-on, gas-fired furnace; (2) heating the entire tube in a larger nonportable furnace; or (3) low-frequency induction heating. The first method ordinarily is most convenient, even though heating may not be uniform and close temperature control difficult. The second is less common in refineries and the same difficulties may be experienced in heating and control. The third usually is tedious and time-consuming. It requires wrapping the welded area with numerous turns of heavy, asbesto-insulated copper cable; but it gives uniform heating and close control of temperature.

The metallurgical section of Continental's manufacturing department has developed recently a successful "new twist" to this induction method. Instead of the copper cable, a coil has been constructed of copper tubing into which the stubbed furnace tubes can be inserted after being welded. Current is supplied by a 25 kva., 180-cycle, Lincoln stress-relieving machine, driven either by a 440 volt motor (preferably) or a gasoline engine.

In practice, two such coils are used, each mounted securely at any convenient height above the ground. Each is energized by a separate generator. Appropriate temperature is maintained by an indicating controller operating a relay to start and stop the machine. A recorder is used also. Temperature is kept within a pre-determined range according to the alloy involved.

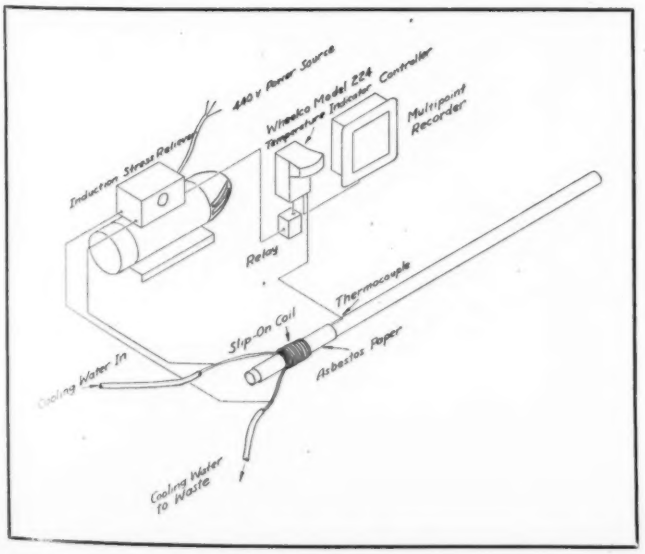
Upon completing a weld, the operator attaches the controller thermocouple to the weld, and wraps a couple of layers of asbestos paper around the tube in the area to be heated. The tube is then slid into the fixed heating coil, using a marker to center the weld within the coil. After the starter switch is pressed, the automatically-controlled machine does the rest.

The welder then welds another tube and places it in the second coil. By the time a third tube has been welded, the first tube is ready for removal to a gas-fired cooling furnace.

Water is circulated continuously through the 0.375 in. copper tubing in the coil. This keeps it cool to the touch even though the weld inside is at 1375° F.

A suggested arrangement for the equipment is shown in Fig. 1, using a motor-driven generator. A Wheelco temperature indicator controller is shown, although any equivalent instrument may be employed. The multi-point recorder is not necessary to the process, but it makes a convenient record for inspection and metallurgical section use. Connection to the copper coil is by clamps. A wiring diagram for the equipment is shown in Fig. 2.

One of the greatest single problems



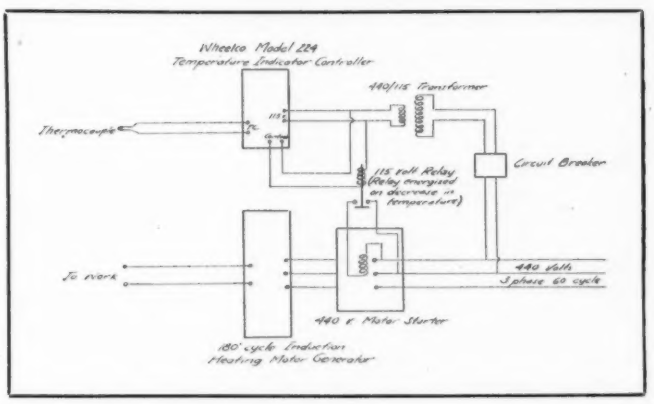


Fig. 1—Left: diagram of field set-up for Continental's stress-relieving process

Fig. 2—Above: wiring diagram of automatic control system for induction generator

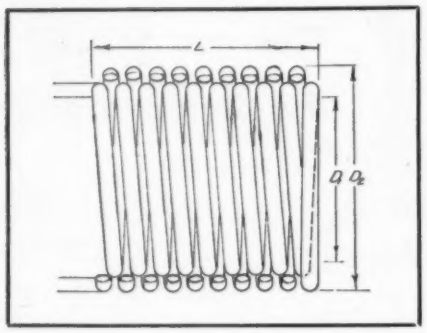


Fig. 3—Coil construction consists of two layers of ten turns each of 0.375-in. annealed copper tubing insulated with tube of Fibreglas

to overcome is in developing a coil construction sufficiently rugged to withstand the rough handling and abuse that is inevitable on the job. A diagram of a coil for a 4½-in. diameter tube is shown in Fig. 3. The insulation was still serviceable after use on a job at Continental's Denver refinery, where 88 tubes were cut out of a vis-breaker furnace and stub-ended. The majority were carbon-molybdenum or low chromium alloys.

One drawback to this system is that the present coil cannot be used where flange connections or short-radius bends and turns are involved. So far as is known, no convenient coil for this purpose is available commercially. Experimentation to develop a suitable arrangement is continuing.

Four steps in the construction of the coil are:

1. Insulate 0.375-in. annealed copper tubing by sliding on 36-in. lengths of Fibreglas tubing.

2. Form coil by wrapping the tubing about a mandrel with a diameter (D_1) approximately 0.5 in. greater than the work for which the coil is intended. Insert short lengths of Fibreglas tape at intervals for tying inside row of turns to outside row. Length of coil (L) and arrangement will be determined by area to be heated and number of turns required .

3. The outer layer of turns, a continuation of the inner coil, is formed closely about the inner layer and tied to it by means of the tapes.

4. Dip coil in baking-type insulating varnish (Formvar No. 300 or equivalent) and bake per manufacturer's recommendations.

In connection with number of turns needed, it has been determined that an optimum number exists for each size of tubing or pipe involved. The particular number shown in Fig. 3 is for 4½-in. diameter tubing. It is suggested that other users develop data on this requirement depending on the particular equipment to be used and the results obtained.

The instruments are not furnished with the generators used. The equipment we used is satisfactory and has a range of 0 to 2000° F. A line of low-frequency induction heating equipment is available also from Electric Arc, Inc., complete with controllers and recorders at extra cost.

Either chromel-alumel or iron-constantan thermocouples may be used, with preference toward the former. In any event, the instrument must be calibrated for the couple to be used. Although not substantiated by experimental evidence, it is believed there will be no appreciable error in temperature measurements from heat induced in the couple itself. It is securely fastened to the weld either by a tack weld, or by inserting it inside and flattening a short piece of ½-in. pipe which has been previously welded to the work.

Process Group Develops Piping System Useful for Speeding up Butane Unloading

A SIMPLE piping system for repressuring butane tank cars with vapors of the butane being unloaded has facilitated speeding up this type of unloading operation at the East Chicago refinery of Socony-Vacuum Oil Co.

As worked out by the process department, the scheme is shown schematically in the sketch in Fig. 4. A conventional unloading pump draws liquid butane from the tank car bottom and sends it on to storage. A ¼-in. repressuring line is tapped into the unloading line on the discharge side of the pump, and ahead of the transfer line to storage tanks.

This line passes through a steam coil to a connection at the tank car dome. A slight pressure is maintained in the line by means of a throttling valve and by the steam coil. Temperature is kept at, or slightly above, the boiling point of butane to assure complete vaporization in the repressuring line.

Since adopting the scheme, Socony has experienced no troublesome delays in unloading butane because of vacuum conditions inside the tank.

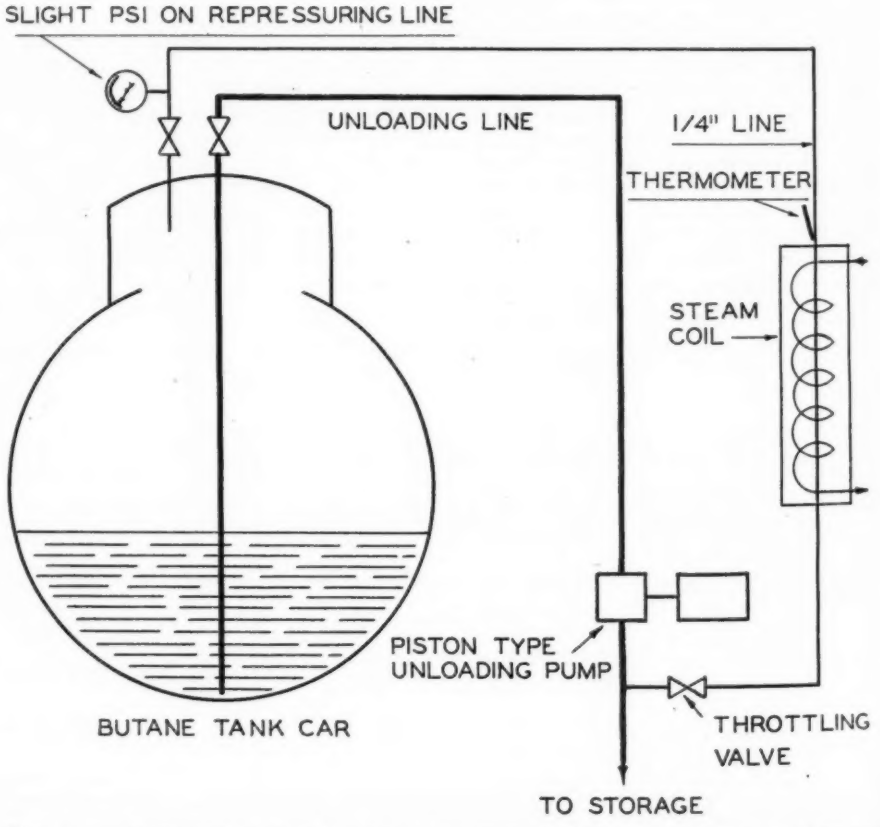


Fig. 4 — Repressuring system aids unloading of butane tank cars at Socony-Vacuum's East Chicago refinery

Make Neat Welds on Thermocouple Tips With Simple, Portable Welding Device

By H. A. FITZGERALD, Assistant Superintendent
Mercury Oil Refining Co., Oklahoma City

THE ends of a thermocouple can be welded neatly together without a welding torch and without oxidizing the metal by use of a simple device developed and used at Mercury Oil Refining Co.'s plant. The "gadget" can be easily carried to the job or used in the shop. It operates on ordinary 110 volt current, and is illustrated in the sketch in Fig. 5.

A small hole, of sufficient diameter to accommodate a small bolt, is drilled in the side of a standard 4-oz. oil sample bottle, about one inch above the bottom. The bolt is then placed in the hole with a rubber gasket on each side and the nut on the outside. Then mercury is poured into the bottle to come about a half inch above the bolt head, and the bottle is filled about 2/3 full with a light transformer, instrument, or motor oil.

The cold ends of the thermocouple are connected to one side of a 110 volt circuit through a light bulb, and the other side of the 110 volt source is connected to the bolt in the bottle. When the thermocouple is immersed in the oil until it touches the surface of the mercury, an arc forms which makes a good, clean weld. The thermocouple is then removed, disconnected, and rinsed in acetone or benzol to remove the oil.

The size of the light bulb has to be varied experimentally for different sizes of wire. Bulbs of 200 and 300 watts—or no bulb at all— have been used successfully. However, it has been found that a 300 watt bulb will weld anything up to #20 wire.

No noticeable amount of mercury is used on a weld. The same bottle with about 1½ inches of mercury has been used for about a year with no loss in evidence. Instrument service men here at Mercury Oil have found this an ideal tool for an emergency when no welding equipment is available. The cord, bottle, and bulbs can be quickly disconnected, the bottle corked, and the entire equipment carried around the refinery in a tool box.

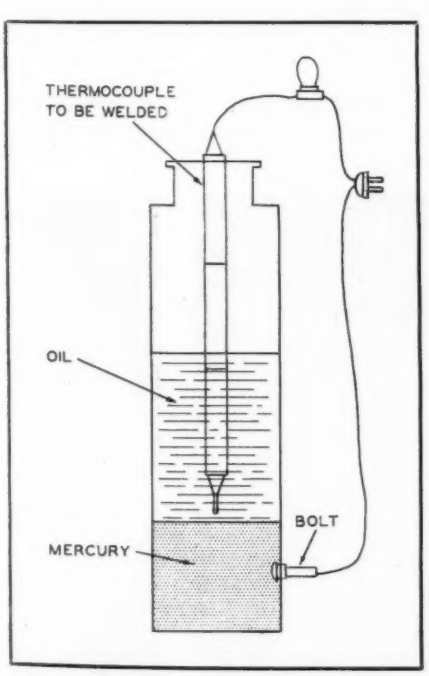


Fig. 5—Diagrammatic sketch of handy device for welding thermocouple tips

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Use Induction Period Calculator For Oxidation Stability Tests

By E. L. KORB, Director, Petroleum Chemicals Laboratory
E. I. du Pont de Nemours & Co., Wilmington, Del.

Design and fabrication of an induction period calculator as described includes a time scale from which the induction period is read and a calibrated template for determining the conventional "break point" in such laboratory methods as the Oxidation Stability Test of gasoline. The five steps of operation of the calculator are presented and illustrated, and some limitations of its use are discussed.

AT the January, 1947, meeting of the American Society for Testing Materials in Washington, the writer presented to Subcommittee A-I on Gum* for their consideration an Induction Period Calculator which had been developed in the du Pont Petroleum Chemicals Laboratory and used with considerable success for the past 8 years. Sufficient interest was expressed in the possibilities of such a device that it was decided to poll the membership to determine whether action should be taken to adopt it as a part of the present method for determining the oxidation stability of gasoline.

The chairman also suggested that an article describing its fabrication and use be prepared for publication. It was recognized that such a paper would reach other users of this or similar induction period methods who are not presently members of the Subcommittee and, in this way, a more accurate appraisal of its potential usefulness established.

The idea of an Induction Period Calculator is not new, several other companies having spoken of units in use in their laboratories at the time the du Pont version was first presented. These Calculators, as described during this meeting, used the same principle for determining the "break point" but, so far as is known, did not incorporate the additional feature of a time scale for calculating the "induction period," as herein discussed.

One of the limitations of the present ASTM D525-46 Method, "Oxidation Stability of Gasoline (Induction Period Method)" is that the determination and calculation of the "induction period" are subject to human error and interpretation.

The method specifies that the technician "record the number of minutes from the time the bomb is placed in the bath until the 'break point' has been reached as the observed 'induction period' at the temperature of the test." The "break point" and "induction period" are defined as follows:

> *"Break point* is the point in the pressure-time curve that is preceded by a pressure drop of exactly 2 psi. within 15 min. and succeeded by a drop of not less than 2 psi. in 15 min."
>
> *"Induction period* is the time elapsed between the placing of the bomb in the bath and the 'break point' at 100° C."

Experience within individual laboratories, as well as cooperative data developed between different laboratories, have shown at times rather wide discrepancies in "induction period" values obtained on the same gasoline samples. Frequently, this is due to differences in interpretation of the "break point" by the various technicians conducting the tests. Another source of error, although somewhat less frequent, is the incorrect calculation of the time elapsing between insertion of the bomb in the bath and the "break point." There are still other errors, inherent in the test procedure, which are not ones of personal judgment, and therefore beyond the scope of this article.

Subcommittee A-I on Gum, charged with the responsibility of maintaining and improving the accuracy of this method, nas recognized for some time the desirability of more rigidly controlling these personal factors in the present procedure.

Principles

The Calculator (Fig. 1) consists of a "rate of pressure change" template and a circular time platform.

The "break point" is quickly and accurately determined by means of the template and is defined as that

* ASTM D-2, Committee A on Gasoline.

Fig. 2—(Step I) The operator centers the chart and the template by the hub in the middle of the time platform

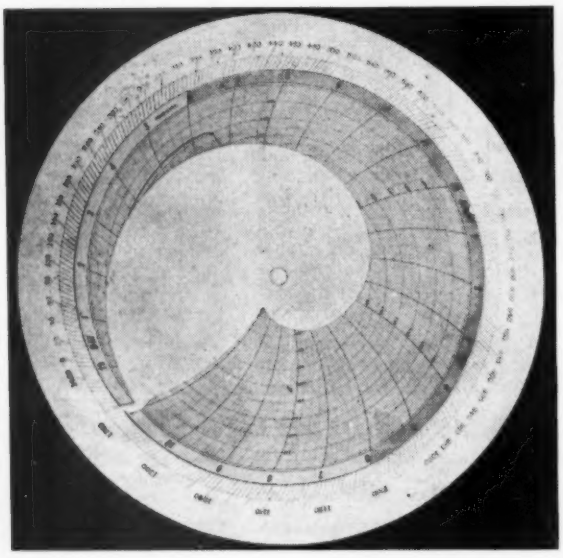


Fig. 3—(Step II) Template is rotated to the point at which the pressure curve almost disappears beneath it

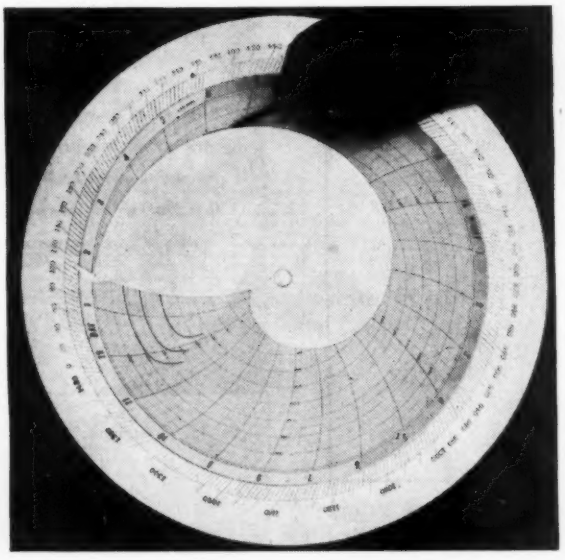
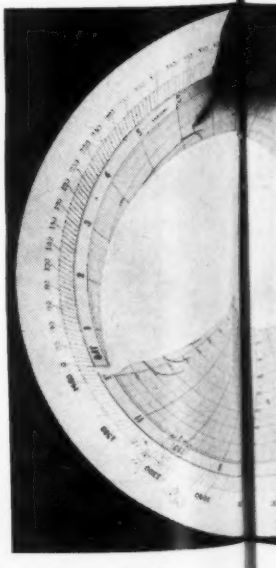


Fig. 4—(Step III) A ma is n of tangency; i.e., poin t w first exceeds p eter



point at which the recorder pressure curve drops below a tangential line produced by the template.

After the prescribed steps leading up to the determination of the "break point" are performed, the "induction period" is read from a scale provided for that purpose as an integral part of the Calculator.

Operation

The operation of the Calculator is in 5 steps as described below:

Step I—Centering the Chart. The pressure chart and template are placed on the platform (Fig. 2). The chart and template are centered by a hub in the center of the time platform.

Step II—Lining up Last Visible Short Segment of Pressure Curve. The template is rotated until only a short segment of the pressure curve remains visible (i.e., point at which curve has almost disappeared beneath template) and a line is drawn tangent to this curve, using a sharp, hard-lead pencil (Fig. 3).

Step III—Marking Point of Tangency. The point of tangency at which the pressure curve leaves the pencil line is marked (Fig. 4). This is the point at which the pressure drop first exceeds the predetermined rate (in this case, 2 psi. per 15 minutes).

Step IV—Positioning the Chart for Calculation. The radial arc edge of the template is then superimposed on the pressure curve at the point where the pressure starts to increase due to immersion of the bomb in the boiling water bath. The chart and the template in the position as just described are carefully revolved until the template pointer is on the zero of the time platform (Fig. 5).

Step V — Measuring Induction Period. Holding the chart and plate firmly in place, the template is rotated until its radial arc edge coincides with the mark indicating the "break point." The "induction period" in minutes is indicated on the time platform by the template pointer (Fig. 6).

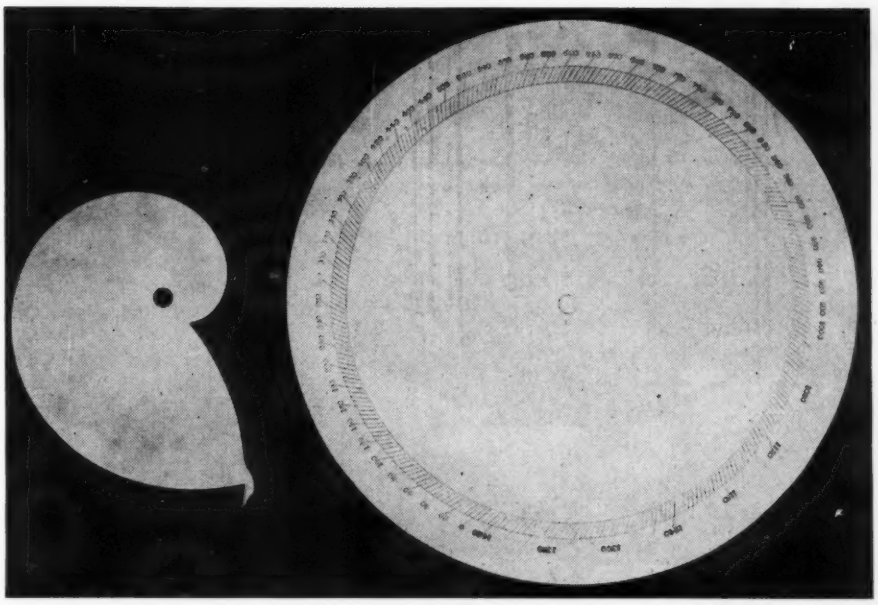


Fig. 1—The Induction Period Calculator consists of a "rate of pressure change" template and a circular time platform

Discussion

The start of the "induction period," defined by this method as the point at which pressure begins to develop, varies slightly from that of ASTM D525-46, which gives it as the time when bombs are immersed in the boiling water bath. This difference is not considered significant.

In defining the "break point," the ASTM method states that it is the point which is preceded by a pressure drop of exactly two psi. in 15 minutes and succeeded by a drop of not less than two psi. in 15 minutes. The Calculator Method uses the first point at which the rate of pressure drop begins to exceed the arbitrary predetermined rate, as the "break point." This difference, in all but rare cases in which the pressure drop follows a two psi. per 15 minute slope over a long period of time, is low and consistent and does not introduce an error of sufficient magnitude to cause concern. Furthermore, either method of defining "break point" could be adopted, depending on user preference and A-I Gum Committee action.

Probably the most critical limita-

) A ma is made from the point e., poin t which pressure drop ceeds p determined rate

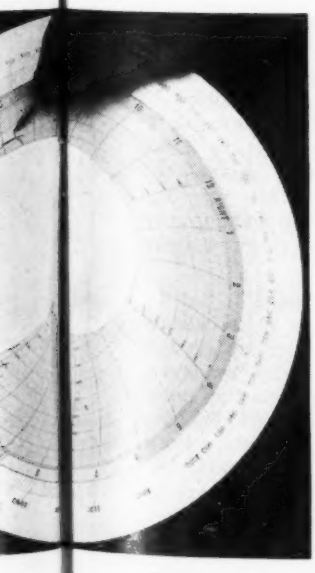


Fig. 5—(Step IV) Chart and template are positioned and then rotated until template pointer is on zero line of time platform

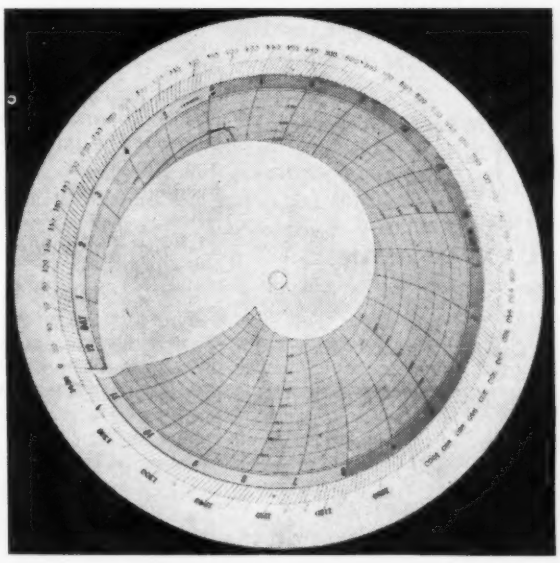
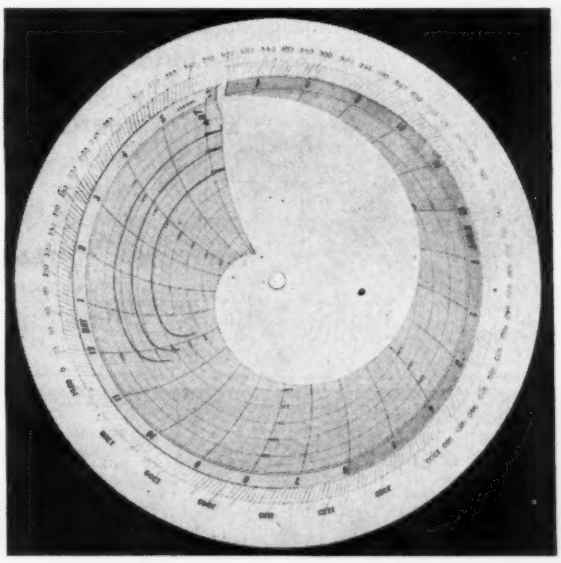


Fig. 6—(Step V) In this operation, the induction period in minutes is shown on time platform by the template pointer



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tions of the Calculator lie in its application in conjunction with various types of existing test equipment. Theoretically, a Calculator can be employed only in conjunction with the recorder pressure system and chart size for which it was designed, if the "break point" as defined is to be consistent throughout. Actually, however, the inherent error in using a single Calculator for charts with moderate differences in diameter and pressure calibration is not significant.

Fabrication of Calculator

A relatively inexpensive Calculator of plywood or cardboard for use with any particular test equipment, and of any desired rate of pressure drop, can be fabricated, using as a guide the standard pressure chart employed by the laboratory desiring such a unit.

First, a hub for the Calculator is made from a wooden dowel approximately ½ in. in length and having a diameter which closely fits the center hole of the pressure recorder chart. This hub is centered on a cardboard or plywood disc, whose diameter is two to three inches larger than the chart diameter, and then permanently fastened. The pressure chart is then placed on the disc, with the hub through center hole, and the time intervals transposed from the chart to the disc by extending the radial arcs of the chart. A circular time dial is thus obtained in 15-minute intervals from 0 to 1440 minutes (for a 24-hour chart), which can then be subdivided into five-minute intervals.

A pattern for the template is made by drawing a curve with the desired slope on a chart and carefully cutting along the line. The curve is formed by plotting points at 15-minute intervals, each point representing a two psi. decrease in pressure from the preceding point. A French curve and sharp pencil are used to join the points. The curve is continued until it returns to the radial arc from which it started or until the lowest pressure reading on the chart is reached. Carefully cutting along this pencil line and the starting arc produces a pattern which is then transferred (including the center hole) to the cardboard or plywood. Before cutting out the latter, the starting radial arc should be projected beyond the periphery of the template approximately ¾ in. to form an indicator to be used in reading the minutes from the time dial.

Acknowledgment

The author wishes to acknowledge that this Calculator is an outgrowth of a suggestion originally made by Mr. Charles Wirth III, presently manager of the Mid-Continent District Office of the Du Pont Petroleum Chemicals Division, Tulsa, Okla. He would also like to express his appreciation to members of the Petroleum Chemicals Laboratory.

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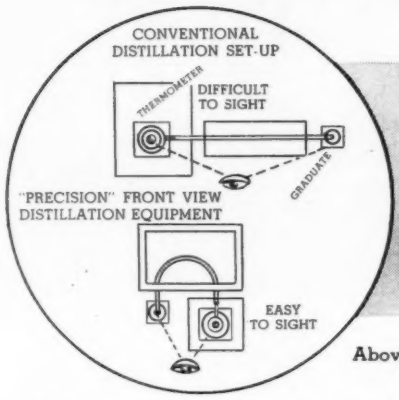

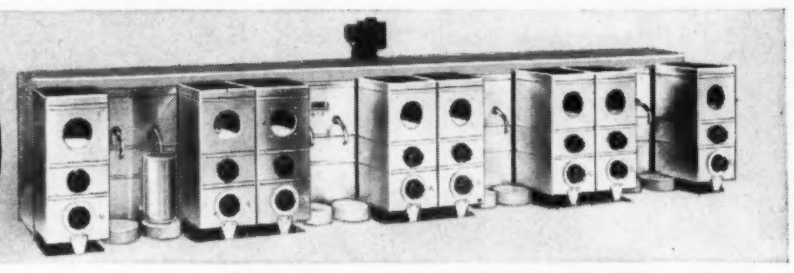

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Shield and exterior of condenser are stainless steel—interior of condenser is heavy copper with a 2" thickness insulation throughout, including the cover. Condenser is equipped with drain and overflow outlets. Available for use with ice or mechanically refrigerated, four unit size and larger recommended for mechanical refrigeration.

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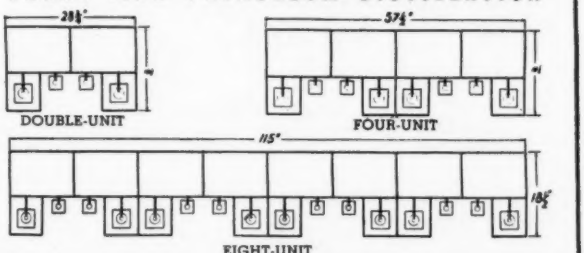

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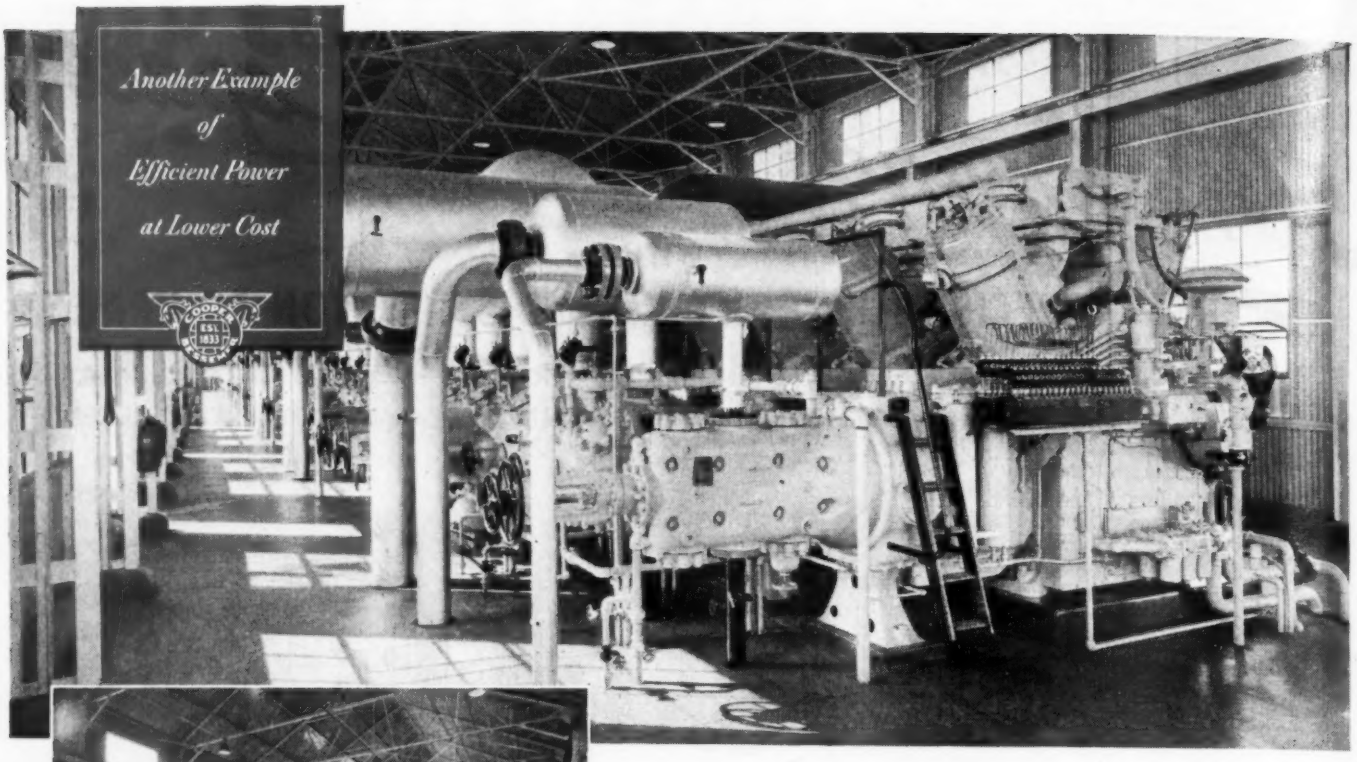
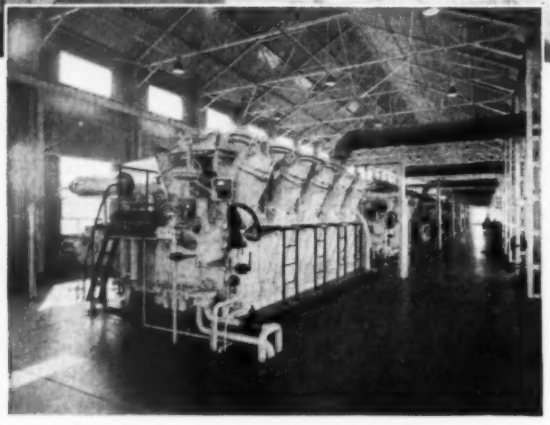
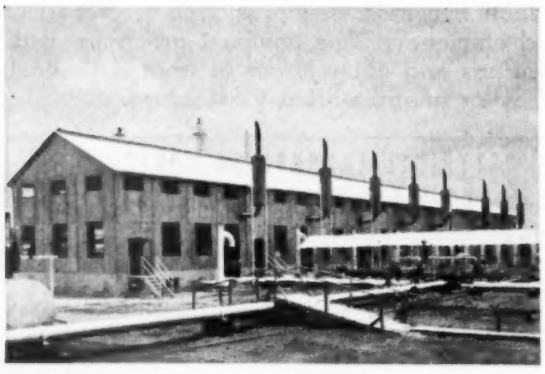




• Engine side of the eight compact 1,000 hp GMV-angle compressors in Magnolia Petroleum Company's West Ranch gasoline extraction plant. Note trim, clean-cut appearance typical of GMV installations.



• Main compressor house, containing Cooper-Bessemer GMV units shown and described above and at right.

How flexible GMV's meet the needs at Magnolia's West Ranch processing plant

THIS gasoline extraction installation is typical of the effectiveness of Cooper-Bessemer GMV-angle compressors in meeting virtually any combination of processing requirements.

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Protective Measures Employed in Storing Complete Avgas Plant for 18 Months

Circulating Gas Oil Through Vessels, Sealing Instruments And Equipment, and Other Practices When Avgas Plant Was Put Away Held Corrosion and Damage to Minimum

By D. P. THORNTON, Jr.
Assistant Editor

EXPERIENCE with the only complete government-owned aviation gasoline plant has proved a refinery can be shut down for a protracted period, yet be quickly rehabilitated and readied to place back on stream. Refiners faced with the problem of putting equipment, an individual unit or a whole plant "on ice" for a protracted period might well consider some of the Do's and Don'ts brought out in a study of the protective methods used in this case.

The property was the DPC-owned 100-octane gasoline plant at Sweeny, Texas, operated by Harrison Oil Co. & J. S. Abercrombie, now owned and operated by Alamo Refining Co., of which Phillips Petroleum Co. is principal stockholder. It was placed in standby condition by the wartime lessee in the 6-months period, Aug. 10, 1945 to Feb. 1, 1946. From then on it was maintained until turned over to the purchaser by the Victory Warehouse Co. of Houston, part of the Fisher G. Dorsey Interests. Work in the maintenance period was under the direction of R. L. Leinweber, Jr., manager of the Victory company.

Crude throughput capacity for the Sweeny refinery is variously stated as ranging from 18,000 to 22,000 b/d. It is equipped with a 13,000-b/d two-stage Fluid catalytic cracking unit, 7000 b/d thermal reforming, 1500 b/d isomerization, 4000 b/d HF alkylation, plus acid treating and TEL blending units.

Production of the plant as reported by Defense Plant Corp. was as follows: 8500 b/d 100-octane gasoline, 3500 b/d 80-octane, all-purpose gasoline, 3500 b/d No. 2 fuel oil, 3000 b/d Bunker C fuel oil and small amounts of isobutane and 91-octane aviation gasoline. Other facilities listed include 750,000 lbs. per hour steam generation and 1,729,000 bbls. tank farm storage capacity plus necessary utilities.

Off-site facilities consist of a barge terminal four miles east of the refinery with 60,000 bbls. of storage and the deep water ocean terminal at Freeport, some 28 miles southeast of the refinery, with 430,000 bbls. of tankage, pump station and two boilers. In addition there are pipe lines to the two terminals and a privately-owned cycling plant three miles south of the refinery.

The Victory Warehouse Co. used a maintenance crew of 14 men for the entire 18 months period the plant was in their custody, augmented by a 13-man guard crew to protect the widely scattered facilities from vandalism and theft.

The RFC office in Houston is said to have estimated it would cost $500,000 to put, and keep, the plant in standby condition. Alamo authorities say that cost of placing this facility in "Class II standby" by the wartime operator's crew was reported to them as having been "in excess of $250,000." According to a Victory official, it cost the government approximately $50,000 to maintain the plant in standby 18 months. Had he been permitted to take certain protective measures which experience later proved would have been desirable, his bill might have risen to $55,000 for the 18-month period.

Principal damage noted by the purchaser, Alamo Refining Co., was corrosive attack on the HF alkylation unit; damage to vessel insulation, resulting from corrosion failure of poultry mesh reinforcement and tie bands; corrosion of water-submerged steel condenser tubes, and internal corrosion of vessel walls above the oil level, leaving a considerable accumulation of flake rust scales on bubble decks and in connecting effluent lines. Severe atmospheric corrosion of bolting was noted where it was not serviced; this condition was particularly true in the tank farms. Likewise, pipe nipples entering vertical insulated vessels and lines were damaged by the same cause, necessitating replacement of approximately 80% of them.

The balance of the equipment, including motorized transport, pumps, most vessels, storage tanks and cooling towers, was in good condition. Purchaser was agreeably surprised at the generally good condition in which the plant was found, the more so considering the small maintenance crew used.

The maintenance contractor moved into the plant the day the wartime operators' crew moved out. This, it is believed, was an important factor in preserving the plant, since corrosive attack and general deterioration from lack of attention had no time to start. The considerable delay in placing some of the other avgas plants in storage after the fires were pulled is considered responsible for much of the damage said to have been found in them.

The particular location of the plant, 20 miles from salt water, in flat marshy terrain and with high atmospheric humidity, intensified the ordinary elemental attack to be anticipated. In addition, freezing temperatures were to be expected for short periods, and occasional hurricanes.

Methods used in standby-ing the plant were set out in a manual prepared for RFC by Universal Oil Products Co., Chicago, entitled, "Preparation of Aviation Gasoline Producing Units of DPC for Shutdown Under Power-Class II". The basis for conditioning procedure outlined therein was the assumption, by RFC, that the plant again would be in operation within a period of six months after conditioning was completed. Certain changes in the original recommendations were made to fit individual cases at Sweeny and approved by both U. O. P. and RFC.

All process units were shut down in a normal manner, drained, purged of hydrocarbons and made safe for a general inspection. The alkylation and isomerization units required special measures to dispose of chemicals and neutralize all contaminated equipment. Next operation was a general cleaning, inspection, and the required repairs to make the equip-

ment tight. Low sulfur content gas oil was circulated through all hydrocarbon systems and vessels, or else the walls of large vessels were sprayed with it.

DPC instruction to Victory specified that gas oil was to be drained out and returned to plant storage. Actually, dictated by contractor's judgment as necessary for protection, the bottom sections of towers, all product sides of exchangers (below the level of gas oil maintained in the towers) and many pumps were left partially or completely filled with gas oil. It is reported that original intentions were to recirculate oil through all units to recoat interior surfaces with a film of oil every six months. This was never done, however.

In general for heat exchangers, water and steam lines were disconnected from coolers, condensers and steam reboilers. Tubes were blown free of water. Water boxes of submerged type condensers tubed with steel were left full of water to which was added a certain amount of quachrome glucosate. The product side of this equipment was left full of gas oil except in cases where this equipment was located above the level of oil maintained in the system.

Handling of Tankage

All low pressure storage tanks which were empty or could be emptied, within the plant proper as well as on the tank farm, were filled with water from the plant's treated water system as a ballast against probable hurricane winds. Low pressure tanks for products with flash points of 140° F (Pensky-Martin) or below were drained and freed of gas before filling with water. Those having held materials with higher flash points were drained as far as possible before ballasting with water. High pressure tanks were cleaned, freed of gas and closed in except for breathing devices.

All were spot-painted as needed and majority of tankage at the plant has its original coat of paint. No rust inhibitor was used as it was felt the products which had been in the tanks would afford protection. By comparison, tanks at the Freeport terminal, filled with products until approximately six months before Alamo took over, were filled in the interim with raw, untreated water. Upon inspection they were in much worse condition, comparatively, than the refinery tanks filled with treated water and in standby for 18 months.

Water was run over all wooden parts of cooling towers semiweekly, to keep them tight and to prevent deterioration and storm damage. Equipment containing water and likely to be damaged was drained when freezing weather threatened. Utility water lines likewise were drained at such times.

Flocks of sheep were pastured on the tank farm and at every other point where there were no operating buildings or equipment and thus little likelihood of dangerous chemicals on the ground. They kept the grass adequately "mowed" for fire protection and general appearance's sake, and the novel "mowing machine" required little human attention. The new operator still uses the sheep.

The flocks were balanced in the proportion of one sheep to every 1.5 acres of grazing area, the generally-accepted density in the vicinity. This made it unnecessary to purchase feed as "maintenance and repair expense" for the mowing "machine." Profits from the annual sale of wool and the flocks' natural increase paid for their supervision. Other areas, such as in the vicinity of large tanks or within the various plant enclosures, had to be mowed in the more conventional manner.

In making the refinery ready for standby, exhaust pipe vents and air intakes for compressors and other equipment opening to the atmosphere were closed, generally with paint buckets up-ended over them and wired securely. Where unusual shapes were encountered, sheet-iron covers were fabricated. This prevented water from entering during rainstorms and also eliminated most of the condensation which might have seriously damaged valuable equipment internally.

In general, the following rust preventives were used:

U. S. Ord. Spec. AXS-934, Grade 2, SAE 30 (oil),

U. S. Ord. Spec. AXS-674, Rev. 2, SAE 30 (oil),

U. S. Army Spec. 2-84-B (grease), and U. S. Army Spec. 2-82-C (grease).

Acid pumps were neutralized, dismantled, cleaned, coated internally with Spec. 2-84-B grease and reassembled. Duraseal and metallic or graphite packings were removed from all pumps and replaced by braided flax packing impregnated with AXS-674 oil. Water lines were disconnected, water jackets blown out. Pump cases were left full of gas oil and rotated by hand once weekly. Cooling water pumps, boiler feed pumps, and the like were blown free of water and left empty.

Steam supply and exhaust lines to turbines were disconnected and cases drained. Bearing oil reservoir was drained and filled with AXS-934 oil. Packing boxes were filled with 2-84-B grease and the governor assembly was sprayed with AXS-674 oil. Shafts, valve stems, trip levers and other bright parts and bolting were greased with Spec. 2-82-C oil. Carbon rings were not removed.

Water was drained from the jackets of all compressors, including all coolers and piping. Oil was drained from lubricator and piping, refilled with AXS-934. The compressor-and power-end cylinders, valves, valve ports and covers were sprayed with AXS-934, while exterior bright parts were coated with 2-84-B. They were turned over by hand once weekly, a schedule followed for other equipment items, such as steam pumps and other steam-actuated devices, to keep them lubricated and prevent "freezing" of bearing surfaces.

After the first six months of standby there was no steam in the plant, but electric power remained available. Consequently all electric motors located inside buildings also were turned on for 15 minutes every week; at all other times they were covered. Electric motors exposed to the weather were dismantled and stored in a dry place; shafts were greased and the parts covered with water proof paper.

Instruments Sealed

All instruments other than simple temperature and pressure gauges were given special protection. They were disconnected and all holes entering the case were tightly plugged. On the first dry, sunny day, instrument cases were opened, a quantity of silica gel and a piece of moisture-indicating paper placed inside, then sealed at all openings with a coating of hot beeswax. Afterwards they were inspected at least every ten days to two weeks. If the indicator subsequently showed moisture, a new supply of desiccant was placed inside and the instrument resealed.

Special attempts were made to protect the HF alkylation unit against corrosion. In the acid section, however, no attempt was made to expend any great effort on those portions of the equipment having a normal life-expectancy of less than two or three years. It was known this section already was "shot," and pretty much a question of salvage, anyway. Vessel interiors were first neutralized, and then thoroughly dried out with hot air. Next the vessel walls were washed thoroughly with gas oil and all openings sealed.

The Fluid catalytic cracking unit received careful attention. It was in need of a normal turn-around when the plant was closed down and consequently was one of the first major units to receive attention in the standby preparations. Catalyst was removed to the storage hoppers and all moving equipment associated with this operation was operated once through its cycle in order to give every portion a thorough bath of heavy oil.

Reactor and regenerator linings next received attention, with all debris

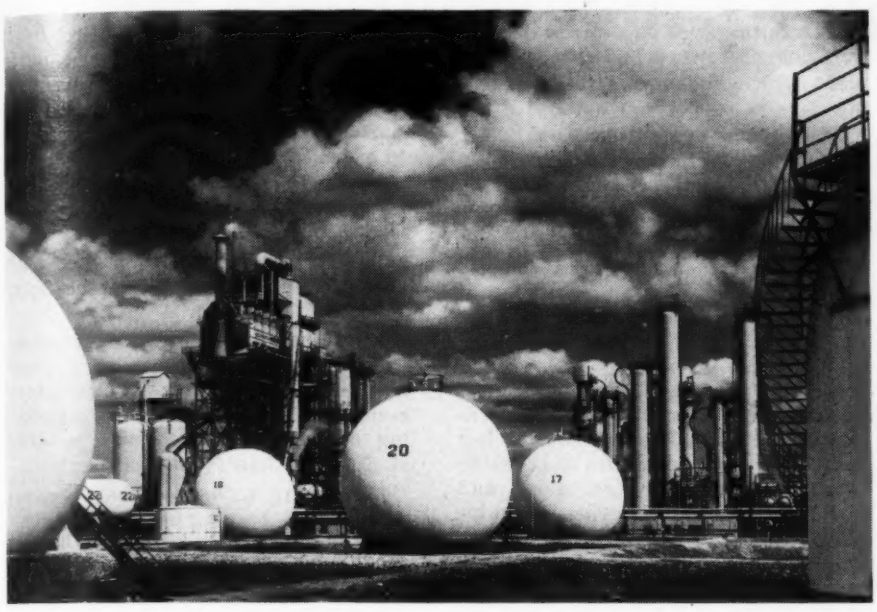

Photo courtesy Wyatt Metal & Boiler Works

Government-owned avgas plant at Sweeny, Texas, before being put in storage. Visible is part of the tankage. Fluid cracking unit at left and some of the distillation equipment at right

and small quantities of adhering catalyst being removed. Lining and insulation then were examined carefully and repaired where necessary. The large slide valves were painted, moving parts heavily coated with grease and wrapped with water-proofing.

Small lines, including aeration lines, quench lines and the like, were blinded off on both line and vessel side; similar treatment was accorded vapor and charge line on the reactor. Linings in the hot air line, air heaters, standpipes, risers, flue gas line off the regenerator, including waste heat boiler, precipitator and stack, were dried out with hot air. This assured that the whole system, including reactor and regenerator, was thoroughly dry. The air inlet then was blinded off at the blowers while the system still was hot and a special conical lid was placed over the stack to seal it also.

The entire catalytic cracking structure then was given attention. Members and vessels were scraped where they were not insulated externally, and coated with red lead, asphalt-base paint or chassis-black paint on a "spot" basis. Insulation was examined, repaired where necessary, sealed with material recommended by the insulation manufacturer and coated with asphalt-base paint. Periodically the unit was re-inspected and repaired or painted as this indicated. Instruments were treated as previously described.

Distillation equipment and supporting members were treated similarly to the general plant facilities, including pumps, motors and the like. The regeneration air preheater had its insulation put in good shape, followed by drying out with hot air and sealing. Heat exchange equipment was treated as mentioned previously. Air blowers were greased and turned over by hand periodically.

No unanticipated difficulty was encountered in storage proofing the catalytic cracking unit. When started up by Alamo, it is stated the procedure was no more difficult or unusual than following a routine shutdown, except that an unusually searching inspection was made and a few items in the "questionable condition" category were replaced. Some work of a revamping nature also was done on this unit by the new owner but this was not necessitated by elemental damage during the 18-months shutdown.

Plant furnaces generally were cleaned up as necessary, including the tubes. Insulation was repaired and external insulation sealed and painted. Exposed metal was painted. Small auxiliary equipment was treated as in other parts of the plant.

Steam System

Lime was spread in all drums and fireboxes in the boilers at Sweeny and the Freeport terminal. This absorbed the moisture condensing during atmospheric changes. Every few months, when its condition dictated, this was turned over with shovels to break up the crust which formed with moisture absorption. The usual period was two to three months.

With this exception, no other precautions were taken other than to operate pumps by hand if they were not connected to electric power. Likewise, no attempt was made to fill products lines with rust-inhibited water or inert gas since it was believed products adhering to the walls would afford adequate protection. Since some of the fire-fighting equipment was steam-powered, the contractor wished to retain stand-by steam for a possible emergency but government agencies would not permit this for economy reasons.

All automotive equipment, except mobile fire equipment, was covered and on jacks. Each week the motors were run for a short period, running through the gears to keep transmission and differential gears protected with a film of oil. Mobile fire equipment likewise was run a short distance under its own power. It was kept ready for instant use since there still were considerable quantities of inflammable products stored about the plant, especially on the tank farm. In addition, exceedingly stringent no-smoking rules were enforced everywhere about the plant. Guards were charged to see that smoking was permitted only in designated locations where no fire hazard existed.

From the very beginning of the general preparations for standby coatings on externally-insulated vessels were sealed with a special sealing compound recommended by the insulation manufacturer, and an asphalt-base paint applied as often as necessary. Insulated lines were painted with asphalt paint, and uninsulated lines were scraped and painted once only with either red lead or asphalt base paint; sometimes both were used, the lead serving as primer. Spot painting was resorted to as necessary. Large valves were moved occasionally and kept lubricated; otherwise treated as uninsulated pipe.

Damaged Equipment

When the plant was turned over to the new owner after an 18-months shutdown only two cases of major damage were found. Interiors of acid-containing vessels in the alkylation section were badly rusted, and rust also was found in the interior of many other towers and some heat exchangers. A few protected instruments had been damaged to some extent by moisture. Some rust was found in steam lines and the boilers but of relatively minor nature.

No detailed statement concerning condition of the alkylation and isomerization units can be made, since these units are not in operation. However, it is known from limited inspection that damage occurred especially in the alkylation unit, although the extent of repairs necessary to place either in operating condition is not known. It is believed the metal, or the passivating scale which always forms

in the presence of hydrofluoric acid, had absorbed a considerable amount of the acid. This was not neutralized by the wash, and the final wash with gas oil likewise did not inhibit subsequent corrosive attack.

In the towers, most of the rust was in flakes or sheets. A wash-out was believed sufficient. However, in the middle of the first run after the plant was recommissioned, it was necessary to shut down and again remove rust missed the first time, which had plugged lines and restricted circulation.

Victory Warehouse officials believe that even this damage could have been prevented if they had been permitted to do two things: (1) circulate clean gas oil through all vessels at least every 30 to 45 days. (2) Maintain a low head, 60 psi., of steam on boilers and system at all times except when actually turning steam-driven equipment over three or four times a month, when the normal 400 psi. would have been necessary.

The first precaution would have prevented rusting in towers and large vessels and would not have degraded the gas oil. Significantly, no rust was found in exchangers which had been left filled with gas-oil on both sides. Neither was there rust in those portions of towers and other equipment which had been left filled with oil.

The second precaution would have prevented boiler and auxiliaries, including steam lines, from rusting internally. It would have facilitated turning over steam-driven equipment.

The government agencies, according to the contractor, considered it entirely unnecessary to circulate gas oil through the equipment periodically. Washing down vessels once, and then sealing them up, should be sufficient, it was reasoned. Reasoning similarly, keeping even a low head of steam up would cost $200-$300 per month for fuel alone and would not pay out in terms of equipment saved. In general, government agencies were making every effort to preserve the plant at the least possible cost and still have the facilities in reasonably usable condition.

Changes Recommended

On the basis of conditions observed during the inspection and reconditioning of the process units by Alamo, the following changes in standby procedure are recommended:

"The process side of all operating equipment should be left entirely full of gas oil, if available. If gas oil is not available in sufficient quantity, the entire systems should be reflushed by circulation at intervals not to exceed five months.

"No changes are recommended in regard to conditioning pumps. Carbon rings should have been removed from steam turbines and boxes packed with rust preventive grease, such as Spec. 2-84-B.

"In regard to compressors, it is considered that the procedure as outlined (in the manual) will give satisfactory results if carefully followed. Respraying of cylinder walls should be done at not less than 90-day intervals.

"In regard to heat exchangers, results from leaving steel condenser tubes submerged in water was found to be very unsatisfactory, even though inhibited with quachrome glucosate. It is felt that the extensive corrosion experienced could have been prevented by draining the water boxes and spraying all steel tubes at intervals with a suitable rust-preventive oil.

"Furnace tubes and fittings were found to be in reasonably good condition. No changes in procedure are recommended. Procedure as followed for instruments can be recommended, and in general, electric motors were found to be in fair condition.

"Steam generating equipment was found in very good condition and procedure employed can be recommended. Likewise, no procedure changes are recommended for atmospheric and pressure tankage.

"All spare parts and warehouse supplies subject to atmospheric corrosion should be carefully coated with suitable rust preventives. This coat should be renewed whenever required.

"From the generally poor condition of vessel insulation and pipe nipples passing through insulation, it can be recommended that extensive precautions should be taken to seal all breaks or openings with suitable materials to prevent rain from coursing down the side of the vessels. Bolting and machined surfaces and the like, to which Spec. 2-84-B or 2-82-C grease was applied were found well preserved. Items not so protected were badly damaged and in many cases, small bolting had corroded to complete failure. The above greases are highly recommended for applications where painting is not desirable."

A number of changes have been made in the processing sequence and procedure of several units since the plant was taken over by Alamo Refining Co. Delays in securing required equipment were largely responsible for several months elapsing between purchase of the plant and its first on-stream day.

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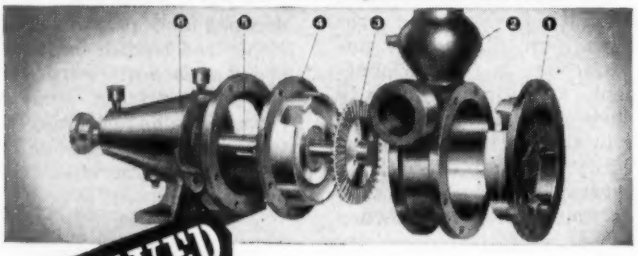

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NATIONAL ENGINEERING CONSTRUCTION SERVICE — OIL STEEL CHEMICAL

Refinery Expansion Across the Atlantic Will Remap the World's Oil Market

By WARREN C. PLATT
Publisher, Petroleum Processing

The increase in refining capacity in England, the Continent and elsewhere, which will largely operate on crude from the expanding Middle East fields, will have important effects on the U.S. petroleum industry. American refineries will find their world markets compressed, and will become more dependent on domestic demand for their products. The overseas demand for Middle East crude may remove the anticipated threat of cheap oil finding its way into our own markets. Whether free competition continues among oil companies in other countries, or whether they come under a greater degree of government control, will influence the political future of the petroleum industry in our own country.

LONDON—The great and rapid expansion of the petroleum refining industry on this side of the Atlantic promises not only to consume a large and increasing part of the vast crude oil production in the Middle East, perhaps a large enough percentage to force America to bid for whatever part it gets, but this big refinery growth is also going to have important effects on the industry, both in operations and politically. If the industry is successful in getting its real story over to the people of England and the Continent, yes, and even to America, the political effects can be good for all the industry over the world. Otherwise they can be very bad.

At the moment the political situation of the industry in England appears good despite the seeming spread of Socialism, which, however, is bringing headaches to its ardent proponents. On the Continent the political situation can more fairly be said to be bad, even ominous. There is hardly a country over there that does not have oil—as well as other industries—under considerable bureaucratic control.

The danger of this government control or supervision is heightened not only by the current shortage and that not by any means all due to worldwide shortage of products but more to dollar shortage, but also because of the presence of many strong advocates of not only Socialism but Communism. All eyes and most peoples' fears are centered on Berlin today. Will the Russians block the United Nations' attempts to keep the roads to Berlin open? Will someone open up with a machine gun tomorrow? The longer that suspense holds, the more people fear a catastrophic "incident." Men here are thinking of what to do with their families, even now.

Significance to U. S. Oil Men

There are three important outstanding factors from an oil viewpoint in these developments:

First, American refineries in all probability are going to lose at least a large part of their world-wide markets except for special grades of oil and other specialties because refineries the world over are going to be built more and more in market centers. While this will be done mostly by American and British money the effect will be to make refineries in America more dependent on their home market.

Second, this wide dispersion of large operating units of production and refining, together with the growth of markets and of marketing over the world, is forcing the large oil companies to speed up a policy they adopted some years back, of decentralization of management and even what may well be called decentralization of ownership. By that is meant taking in local capital not only to conform to the laws of many countries but to get the advantages of local supervision and local political contacts with governments.

Third, the oil companies are discovering that though they may be allied in oil production, and that alliance may extend to joint ownership or dependence upon the same big pipe lines and even refineries, the companies can be naturally, and in fact are, in direct competition in their world-wide distributing systems. The great distances from the home office, complicated local problems of management and government contacts heighten this independence of central management.

The Middle East fields are so vast that they suggest that no two or three geniuses of today can manage

The Aero-Engine Laboratory at the Thornton Research Centre of Shell Petroleum Ltd., built in 1940, was expanded by two new wings in 1945

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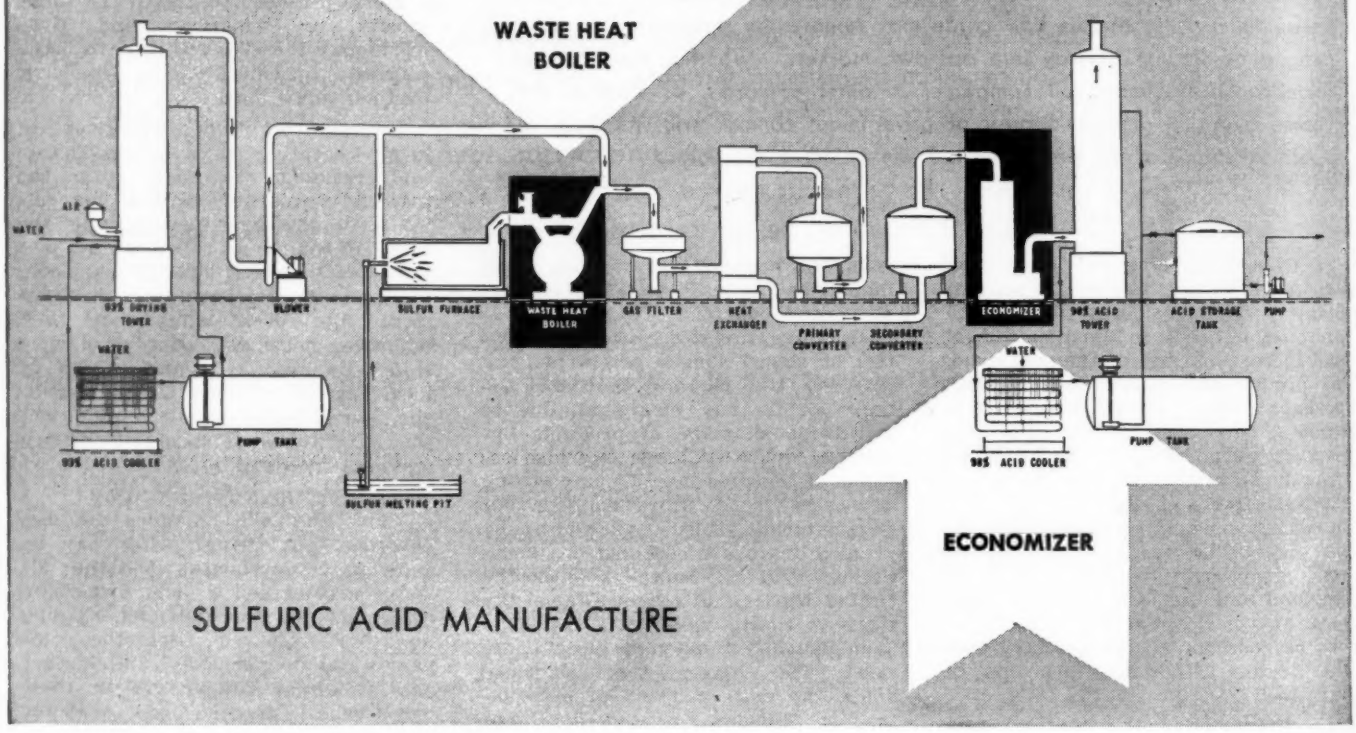

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One wing, the Lubricating Oil Laboratory of the Research Centre of Shell Petroleum Co., Ltd., at Thornton - le - Moor, near Chester, England, and not far from the company's Stanlow refinery. The latest building at the Centre, the Diesel Fuel Laboratory, was completed and formally opened in May. The Thornton Research Centre has been under construction since 1940 and has a present staff of 900 workers

their quick development, and supply both money and management skill to direct the refining and then the sale of such great volume to the whole world. Wherever the inquiring reporter goes he runs into friction, suspicion and secrecy as between companies—and to a surprising extent, when one thinks of the reformers and their glib talk about the ease of enforcing dictatorship-monopolies.

Will Absorb Middle East Oil

This great refining and market development over here puts the crude oil flood expected from the Middle East in an entirely different light back home from that in which we have seen it for some years. This overseas refining development promises to absorb so much of the Middle East crude output that there may be little left to threaten the markets of the U. S. with cheap oil at least for some years. On the contrary, the U. S. and Canada may even have to bid hard for what of such oil they get—and may need—from the rest of the world.

To the big oil companies, both British and American, this supplying of the rest of the world from the Middle East and from their own refineries in these foreign countries, is perfectly natural. The Middle East oil will spread over Europe, Asia and Africa against the competition of North and South American oil and that from the newly revived Borneo and Sumatra country. While today Middle East oil is being sold on the U. S. Gulf Coast price plus freight, because the Gulf Coast is still the largest world supplier, in another several years the volume of Middle East oil may have pushed American oil out of enough market so that there undoubtedly will develop a Middle East market, or price, say based on the Persian Gulf or possibly the Eastern Mediterranean.

Increasing this change is the immediate post war situation. European countries are short of steel as is the world. But, in addition, they are short of dollars to buy steel, refinery equipment and American-dollar oil. Every dollar given Europe in the recovery program is going to be made to go as far as possible. Hence we now are seeing not only a campaign to knock down price of dollar oil at the Gulf, but also to knock down the price of sterling oil in the Middle East. While France and Italy have an ownership interest in Middle East oil, their chief concern, as is that with all other European countries, is to buy the most with our dollars.

Senator O'Mahoney's recent attacks on Middle East oil companies for selling their oil on the Gulf Coast price —using phantom freights, said O'Mahoney—is a part of that campaign. It also can well be considered a direct attack on the actual Gulf Coast price because if the Middle East companies are stampeded into cutting prices, those cut prices will undoubtedly work back against the Gulf prices and other prices in this Country. It may be argued that the big demand will hold them up but with governments, including our own, so directly interested in prices and exercising so much direct control over them, any natural operation of the law of supply and demand can hardly be expected.

Politics In the Picture

Back of O'Mahoney are the sentiments of all overseas consuming countries and opposed to O'Mahoney will be found the South American oil countries, Mexico, American producers, the British companies, and Middle East governments. In other words the forthcoming great developments of the Middle East fields and the construction of refineries dependent thereon, no matter where those refineries are located, may be dictated more by the political tactics of politicians and the immediate desire of these countries to save dollars and some sterling, than by what is best for the long time needs of the Middle East and its oil fields, to say nothing of the interest of the stockholders who have put up the money for this greatest oil gamble in the history of the world.

And this Middle East development can be properly called the world's greatest oil gamble. Not only was it a long shot from the time the first concessions were taken 40 years ago but there is the very practical political question right now of who will own and control those areas tomorrow?

Effect of Russian Seizure

If there is another war, it is a cinch that Russia will grab those oil fields, and it will probably take more navies and armies to stop them than we and Britain could possibly assemble in any reasonable time. Once those fields are held by Russia any attacking forces would be under far greater handicap than ever were the Allies with Germany. Probably for the next quarter century at least Russia and Communists—if the latter last—would dictate the course of industry and of world living and we all would have to pay a mighty high price.

Some may say that this would be the loss of the big oil companies; that it would be money out of the pockets of a few million investors; that they could stand the loss. But consider the loss to our present standards of living, to our ethics and economic ideals if the Communists were to take over those fields? And, of course, they would not pay for them, any more than they have paid for oil and other properties they have stolen in the past.

In this drive to save their dollars and their sterling, these countries are

going to buy all their producing, refining and marketing supplies possible from themselves and from countries with whom they have favorable trade balances, which pretty much leaves out the U. S. For the past several years increasing pressure has been put on certain manufacturers in the United Kingdom and France, and Italy, to produce all the equipment possible for rebuilding the refineries damaged and destroyed in the war, and now more pressure is being applied to get home manufacturers for the great amount of equipment required in the new refinery building program.

American processes, often under joint ownership, and American engineers and contractors are being used, but only the equipment that is not now being made in these countries is bought back in the U. S. This is mostly control equipment, though the Standard of New Jersey did ship over a boiler from the U. S. for one of its refineries in France but this was to keep the rebuilding program on schedule.

Even the big oil companies themselves are finding it necessary to conserve their dollars and build these overseas plants out of money they may have accumulated in the local country. Dollars spent by these oil companies in these foreign countries may not get back to U. S. stockholders, at least in any fair volume, for many years. In the meantime the companies have large dollar demands on them right at home and in South America. They are faced with the biggest consumption in their history and the biggest rebuilding and new building programs everywhere. Company profits may sound big today but the companies are worrying about where the hard money will come from to pay the bill to keep up with demand. That means more production, refineries, transportation, and distribution.

Concerted Action Not Likely

While the common interest of the continental countries may appear to lie in all getting crude oil and products at the lowest of prices, even regardless of profit to the sellers both in the Persian and Gulf Coast gulfs, the chances of these countries ganging up on the U.S. and Britain are not very great. Right now they are fighting among themselves each for a larger slice of U. S. recovery money as against all the others, and in each country groups are fighting against each other for a larger share, each against the others.

They may succeed in reducing the oil prices both in our Gulf and in the Middle East and do it regardless of any ill effect it may have on the long-time development of both oil areas. However, the continental countries have been running too many centuries each on a personally selfish basis for anyone to expect much evidence of any broad-brotherhood-of-man ganging up against the U. S. and Great Britain.

The Communists, of course, would be all for joining up to take over the oil industry, and the Socialists also as a unit, but there seems little indication so far that Socialists and Commies will join up. It may seem hard to draw a clear line at times between the two but there does appear to be a difference especially over here. The average Britisher is still too much an Englishman, a Scotsman or a Welshman to take dictation as to his thoughts, personal life and business from any outfit such as now undertakes to direct the world from Moscow. In the meantime this average Britisher is having about enough trouble trying to chew what his reformers have already bitten off of industry.

Swiss Industry Not "Free"

A strange spectacle of odd thinking and doing in this mess of bureaucracy and government control over here

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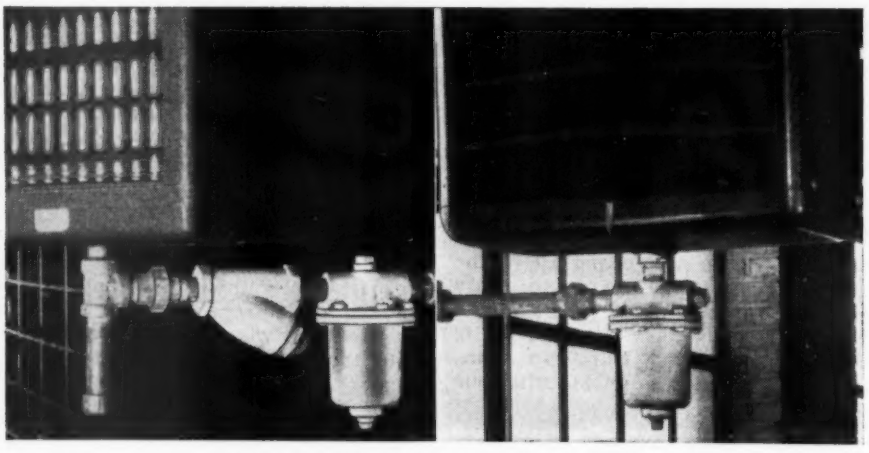
saves fittings either way



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is Switzerland, and perhaps it shows how totalitarianism has made headway. It is a country that prides itself on its early adoption of truly representative government, of giving every man not only a vote but his chance at anything, in any religion, and of developing about as high an average personal skill of its citizens —take the Swiss watches for illustration—as any country. This is the average traveler's picture of "free" Switzerland but when one gets into the country these days he is appalled to find that he can only start a business by getting a government license which means the permission of his prospective competitors, or get a job by vote of his brother workers.

If he does go into business he finds himself in the tightest type of cartel or trusts anywhere; in groups of competitors that cause the government to fix high and umbrella-like prices; that tell competitors how and when to do business. Maybe it is a "free" oil business in Switzerland with one outstanding Independent who has run a shoestring into comfortable fortune and is still young enough to have many years of enjoyment of his fortune before him, but he is like all the rest, a member of the legally ruling groups even though he has advertised himself for years as "Free of All Trusts" or something of the kind.

We Call them "Conspiracies"

All these agreements would be called "conspiracies" in the U. S. and all, or at least all the non-New Dealers, would certainly go to jail. But in Switzerland these past dozen years, one understands that it is the regular thing and much appreciated and approved of by the government.

When the official umbrellas get so high that the buying world will turn away from Swiss products, the umbrellas will of course blow away. The writer found it hard to buy even some inexpensive watches because his recollection was they are not a penny cheaper in Switzerland than back home. Other articles offered by the shopkeepers seemed equally high.

What makes this price fixing work so far undoubtedly is the high degree of skill and honesty of material and workmanship, something you find disappearing in the U. S. under CIO and AFL leadership, as witness the writer's current typewriter; it is the recent second from a highly reputable maker because the first was not assembled properly. This second, after giving much trouble, was again returned to the maker and just before sailing was pronounced O. K. in every particular. The thing literally began to fall apart a few weeks ago just because of downright shiftless workmanship in the assembling.

If a similar sense of "security" which prompts so much of this sloppy workmanship in the U. S. ever comes to the Swiss watchmakers, their watches will fall apart only once and that will end the Swiss watch industry. But today for good material, good workmanship, absolute cleanliness in everything you contact, for excellent food and plenty of it, go to Switzerland—but you will have to pay pretty much New York prices and that after your American dollars have been distressingly discounted.

Hope For Private Enterprise

In all this mess of government supervision and even downright control are some hopeful signs of continuing freedom of private enterprise, especially in oil.

1. The oil industry is spending a tremendous amount of its own money both here and at home, money into the billions and money that is known as "hard money" which manufacturers of equipment have to use to pay their workmen. Such money the foreign governments do not have nor will they have for many years, and then only after they have pulled themselves out of their holes the hard way. Even the Russian Commies beg us for this kind of money as it is something that Communism can't make grow on a bush.

2. The oil industry has the "know how" and the very best of that knowledge and skill is needed in thousands of men to expand the oil industry sufficiently and quickly enough to do the job for mankind that must be done to preserve any kind of a real civilization. While some government bureaucrats even in the U. S. may feel a bit cockey as to their "knowledge" of oil, the oil men should recognize they are being invited to come in with their money, and do the job, even though with more or less face-saving "advice and counsel" by government.

3. The industry has had to decentralize its management still more. It is hard to tell each of a dozen country managers, in a dozen languages how to run the details of a business concerning a dozen entirely different types of people. With the greater increases in refining investment in these countries and hence in marketing, the companies have found that the "old days" of a "master mind" or two at London or New York running all the jobs are gone.

Needs New Type of Management

Then some countries require that local citizens be in the majority on boards of directors, or that a majority of stock must be held by its own citizens. This with the complexity of local conditions and the need of working with the local governments on regulations, some necessary as the result of war and some probably not necessary at all, has caused the companies to employ and train exceedingly competent men in management. They shift them around to other countries in order to give them experience and particularly send them through some years of service in the U. S. One large company has only "shareholders observers" from the home office who are specifically instructed to keep out of all management, just "observe" and "report to foreign shareholders", meaning in the U. S.

All this, together with the great size of these big oil companies, even at home, is teaching the top management a new type of management that, if it is developed and carried on, should go a long way toward meeting some of the rising politicial problems of big corporations.

But how this decentralized management is working, just what it is and who is doing it, must be made so plain that all can see it, so plain that an intemperate political officeholder, careless of the truth, cannot get away with any utterly false and distorted picture.

The companies developing the Middle East for the entire world, have before them a difficult public relations problem. They are way off in the middle of an unknown country where few people go and when they do visit there no one knows how shallow is their "investigation." Typical of this is the story of a certain noisy U. S. Senator who after a half hour entirely at an Arabian airport talked volubly and "authoritatively" of the Middle East oil situation.

Collusion Not Indicated

It is easy for the critics of oil and of other big business to assume that because a half dozen oil companies are all operating in one part of the world with mutual interests in the concessions, and with joint ownership of or working interests not only in the properties but in the big pipe lines and refineries and co-operation in tanker movement, that they are in agreement on prices and marketing territory allotments. If the companies did that it would only be a short time when a lot of countries that have already ventured far into government activity in business, including the U. S., would be having much to say about the management of the oil in the Middle East, and of its prices. This interest would bring more directly into the picture the Middle East countries themselves because they would be loath to let the consuming countries say what should be done with crude and products that originate within their own countries. This interest has shown itself in South America over the years. No country is going to let a dollar get away if it can help it.

While all this pushes the oil com-

Oil was first produced by drilling in 1859, five years after the first Roots Blower was built. We're not good because we're old, but old because we're good.

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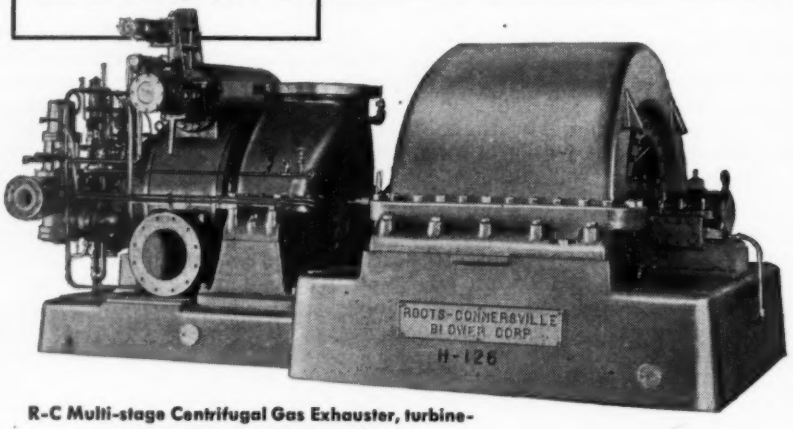

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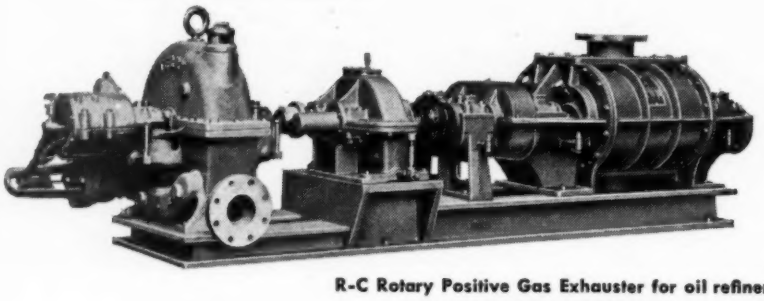

R-C Rotary Positive Gas Exhauster for oil refinery service. Capacity 750 CFM.

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panies into mutual understandings as to their relationship with these governments the companies have a good story to tell of their competitive situations in furnishing their products to the world. The story must be told now, and continually and clearly. The Middle East companies have begun to tell their story, and have organized special staffs to do the job both in the field and in London and to some extent in New York.

Perhaps the companies could go still further with their studies of the form of top management that will more ably meet not only the operating and economic difficulties of the times, but that will be better able to meet the spread of Socialism and Communism, or if you do not like those labels at the moment, then the growing tendency of bureaucrats and political officeholders to strut before their constituencies as great business men, the while they try to tell business how to operate always at the expense of business and the consumer.

Develop Own Brand of "Socialism"

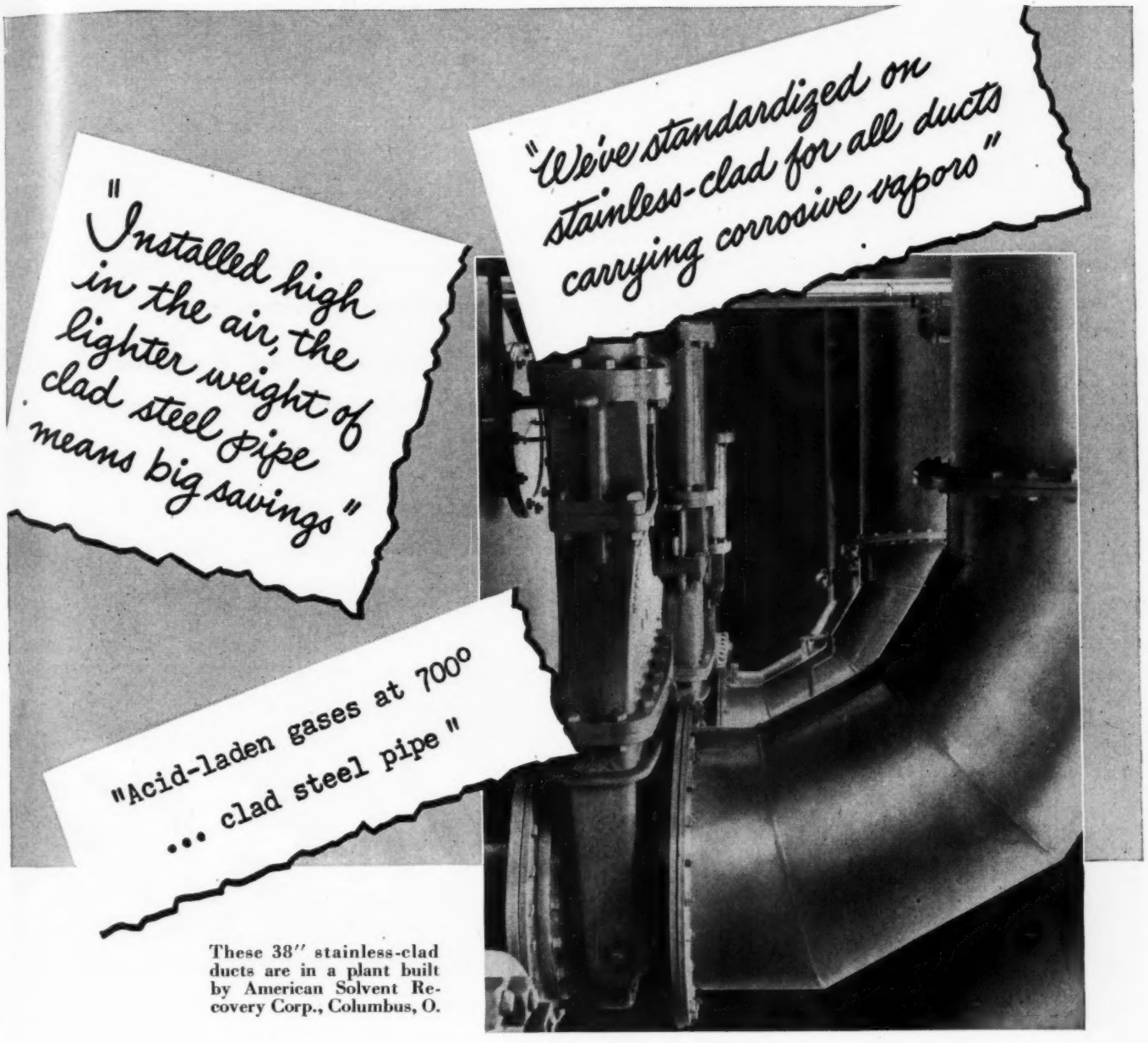
Socialism means that every one, both the thrifty and the spendthrift, have equal shares in business. Why do not the big companies do a better job of developing "socialism" by the thrifty only and then let the spendthrifts know bluntly and plainly that the thrifty are not going to be robbed of their dollars nor their profits from those dollars? This is what present business enterprise is but the public doesn't see it that way.

Middle East oil is in such an important position, so much in need of vast sums and operating skill that can only be given by a few companies; its products are of such vital importance to the world of tomorrow; and its political position will always be most delicate, that this new oil area suggests itself for the most courageous thinking and doing by private ownership and private management in laying out a policy to save private enterprise.

Decentralize Management

The thought that suggests itself is along the lines of concentration of capital by private interests with the greatest possible decentralization of management and hence the maximum of sound competition, between the units even of the one ownership.

At all events, no matter how one views the situation, the Middle East offers the oil industry the great opportunity to turn the tide of government from business. And it also offers the sad alternative of the possibilities of skidding, not only the oil business of the Middle East but in course of time all the oil business under government "supervision" or "control" or even Socialism.


"We've standardized on stainless-clad for all ducts carrying corrosive vapors"
"I installed high in the air, the lighter weight of clad steel pipe means big savings"
"Acid-laden gases at 700°
... clad steel pipe"

These 38" stainless-clad ducts are in a plant built by American Solvent Recovery Corp., Columbus, O.

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Choose the cladding—nickel, stainless steel, Inconel or Monel—according to the corrosive gases you are handling. Piping 18 inches and up is being produced regularly from Lukens Nickel-Clad, Stainless-Clad, Inconel-Clad and Monel-Clad Steels to provide economical protection for refineries, chemical plants and other processing work. Cladding 10% or 20% of total plate thickness suits most applications.

Ask your fabricator to quote on piping, ducts and gas lines made of Lukens Clad Steels. Bulletins 255 and 338 give data on all types of clad steels. We'll gladly send you copies. Lukens Steel Company, 443 Lukens Building, Coatesville, Pennsylvania.

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Although the two MEK solvent dewaxing plants shown here appear to be identical, they differ in many important details.

After the first of these two plants had been ordered, it became evident that a "duplicate" would meet the manufacturing requirements of another company.

We say "duplicate" with reservations, for although oil and solvent charges are the same, many changes were necessary to adapt the second plant to its own environment. As an example, an entirely

DISSIMILAR

different system of refrigeration was employed (turbine-driven centrifugal in place of gas-engine reciprocating).

Nevertheless existing designs were extensively utilized, and a large number of duplicate equipment orders were advantageously placed. Construction management plans were synchronized and substantial over-all economies were realized—not only in investment cost but, more important, in a very much reduced completion time during a period of serious material and labor shortages.

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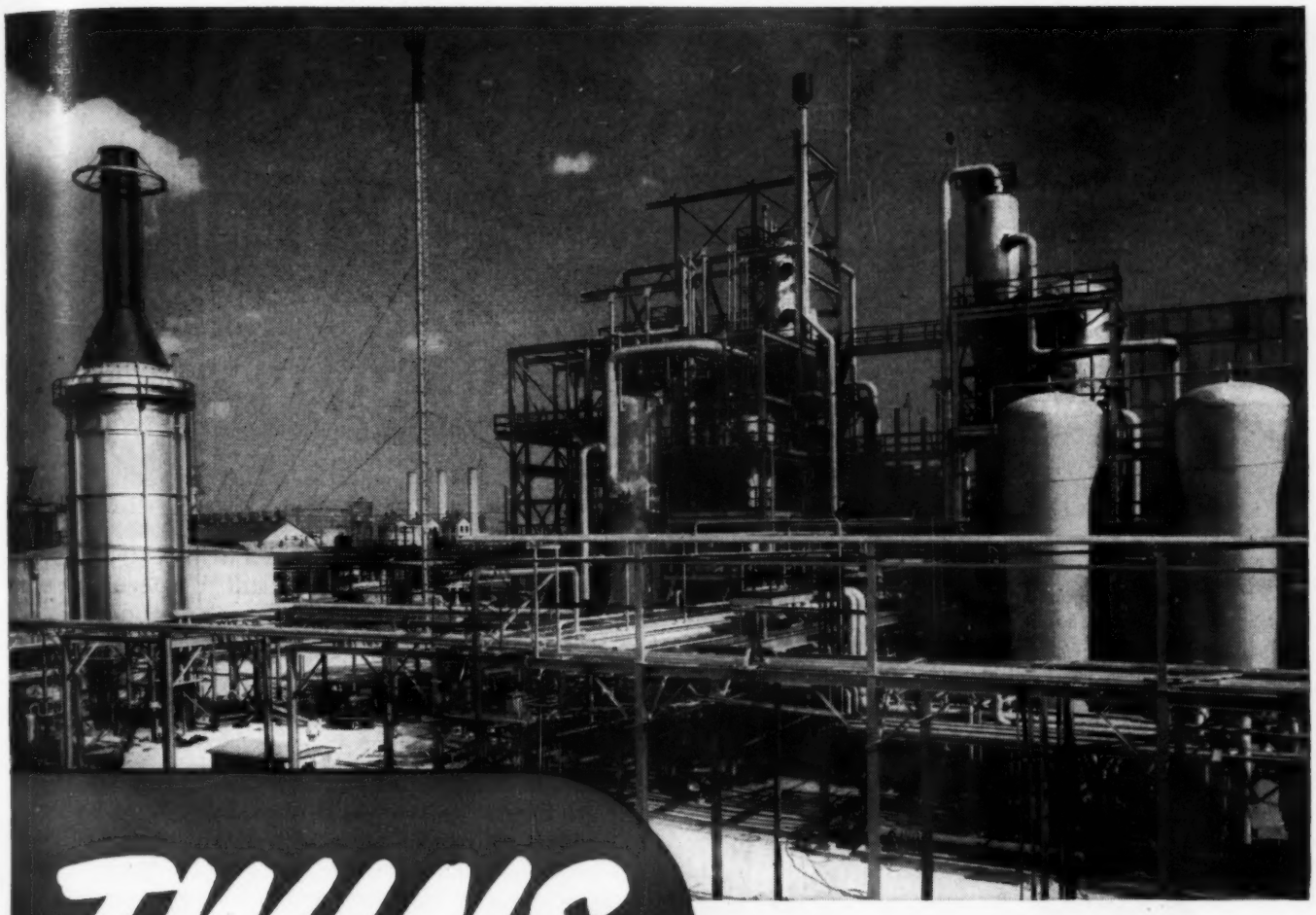
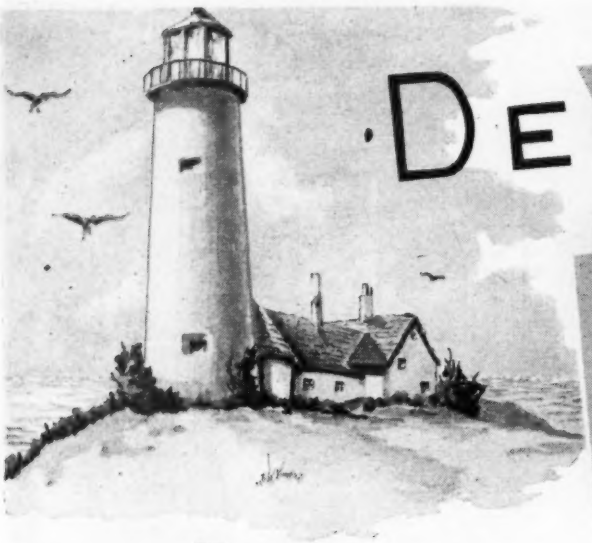


TWINS



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Just as mariners depend on lighthouses to safeguard their ships, so the men of industry depend on their flow control equipment to safeguard their manufacturing plants from "going on the rocks" of costly shut-downs.

With a background of more than a century of making valves—and valves only—Powell Engineers know how to make a valve dependable.

And because the Powell Line is so *complete*, there are Powell Valves—in Bronze, Iron, Steel, and the widest range of Corrosion-resistant materials ever used in making valves—specifically designed and made to give long, dependable performance in each and every flow control service known today.

It pays to consult Powell Engineers on all your requirements for flow control equipment.

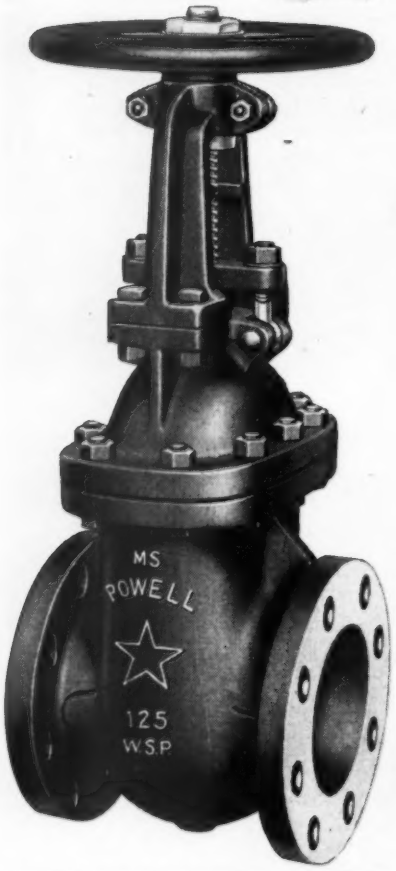

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge. Tapered double wedge can be provided in sizes 2" to 12", inclusive. Also available in All Iron.

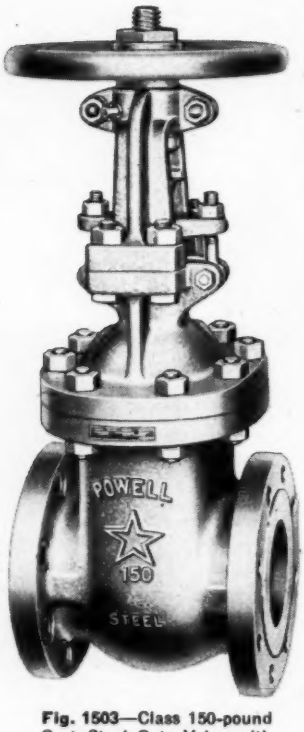

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

Fig. 3061—Class 300-pound Cast Steel Swing Check Valve with bolted cap and flanged ends. Disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

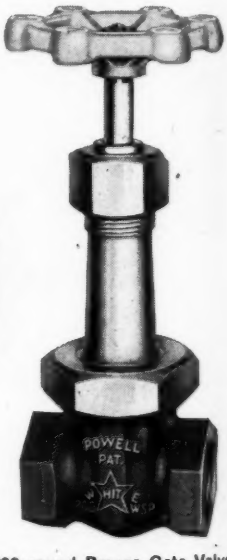

Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

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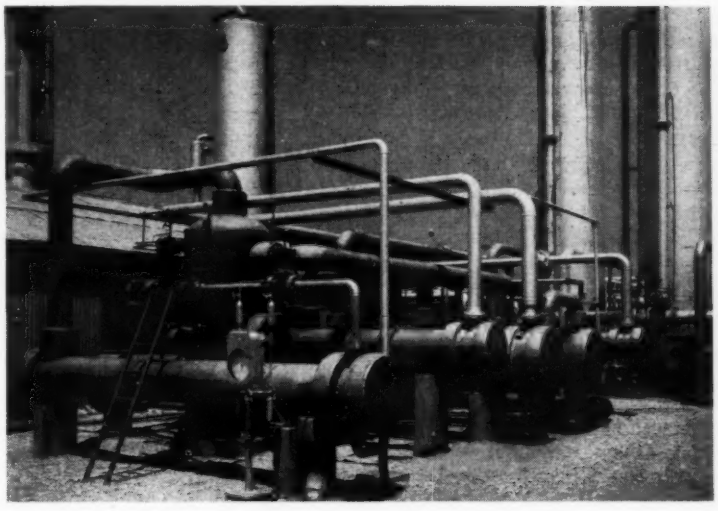


This month's cover is a general view of the propane refrigeration unit at Wilmington Gasoline Co.'s Terminal Island, Calif., plant. Left to right: propane superheater, accumulator, low pressure gasoline chiller, oil chillers, de-oiler, and high pressure gasoline chiller. Unit stepped up plant's natural gasoline output from original 42,148 gals/day to about 61,000 gals /day. This photograph as well as those on following pages furnished through the courtesy of Parkhill-Wade

Natural Gasoline Plant Increases Output By Using Propane Refrigeration Unit

By JOHN C. ALBRIGHT

SIGNIFICANT gains in yield of natural gasoline through use of propane as a refrigerant for improved cooling of both absorption oil and wet gas have been obtained by the Wilmington Gasoline Co. at its Terminal Island plant, Wilmington, Calif.

In a full-scale commercial unit, placed in operation in January, 1947, natural gasoline production was first stepped up from 42,148 to 49,129 gals./day, while throughput of wet gas went from 42,819 to 44,935 MCF/day. In other words, the plant handled about 5% more gas and yielded about 16.5% more commercial natural gasoline. Butane and propane output increased slightly also. Plant efficiency was raised from 91 to 101.2%, while the gasoline content of the wet gas remained constant at 1.08 gals./MCF. These figures were for three-week periods before and after installation. (See Table 1, Columns 1 and 2.)

This first section in the Wilmington installation was designed to effect a reduction of 15° F. below the temperature normally attained with atmospheric cooling on the lean absorption oil and the raw gasoline production from the absorption system and the stills. Addition of a second chilling section about six months later permitted a reduction of 10° F. more, making the total chilling capacity of the complete plant 25° F. below the normal obtainable with atmospheric cooling. Comparisons of operations after the second installation are shown also in Table 1, Columns 3, 4, and 5.

The two three-week periods indicated in columns 3 and 4 for before and after the second chiller installation were during July and August. These are the warmest months on Terminal Island, when more natural gasoline components will flow with the wet gas. At the same time, however, the higher temperatures make it more difficult to extract and condense the desired fractions, especially butane and propane. Gas volumes had increased to 50,203 MCF daily, and the gasoline content had risen to 1.25 gals./MCF.

In the period before the addition was installed, propane and butane production had amounted to a daily average of 16,993 gals.; plant efficiency was 104.5%. After installation, gas volume remained substantially the same as did also gasoline content, but propane and butane production increased about 31.5%, to 22,342 gals./day, and plant efficiency went up to 106.5%.

In the period covering more recent operations (see Col. 5, Table 1), gas volumes had increased still further—6.5% over the August period—but with the anticipated drop in gasoline content due to cooler weather, to 1.15 gals./MCF. However, propane and butane, along with LPG, had increased about 62.5% over the Aug. 10 to 30 period, showing that extraction of the low boiling fractions was satisfactory.

Referring again to Table 1, it is interesting to compare the results before using propane refrigeration (Col. 1) to those of a year later (Col. 5). The volume of gas processed in the second period had increased 25% over the 1947 period, but natural gasoline produced had risen about 46%, and the combined total output had increased about 51%.

Artificial cooling of one type or another has been tried in gasoline plants for increasing output since 1920, when ammonia refrigeration was attempted at Burkburnett, Texas, with questionable results. For

TABLE 1—Liquid Hydrocarbon Production (Average—Gals./day)

	Col. 1 Initial Installation Before	Col. 2 Initial Installation After	Col. 3 Second Chiller Addition Before	Col. 4 Second Chiller Addition After	Col. 5 Recent Operation
Period	1/1 to 1/21/47	1/25 to 2/14/47	7/20 to 8/10/47	8/10 to 8/30/47	2/10 to 2/29/48
Nat. Gaso.	42148	49129	65312	66045	61525
Butane	12658	12794	9271	11958	16296
Propane	10124	10385	7722	10384	14413
L.P.G.	.....	.....	.....	.....	5489
TOTALS	64930	72308	82305	88387	97723
Wet gas treated (MCF/day).	42819	44935	50203	50262	53505
Gaso. content by charcoal test (gal/MCF)	1.08	1.08	1.25	1.23	1.15
% Gasoline extraction efficiency, by charcoal test.	91	101.2	104.5	106.5	103.2

several years thereafter, very little was done to improve condensation except through changes in design of cooling towers and coils. Natural gasoline manufacturers were left to depend upon the evaporation of water to obtain absorption and condensing temperatures.

More recently, however, artificial cooling has again been investigated by plant designers, leading up to the use of plant propane as a refrigerant. The Wilmington Gasoline Co. installation is one of the latest units to use propane. It was designed, erected, and put into successful operation by Parkhill-Wade, consulting and construction engineers of Los Angeles, Calif.

The reasons for adopting the propane refrigeration system were both economical and logical. In the Terminal Island plant, increased volumes of wet gas were placing a heavy burden on existing extraction facilities. A still greater supply was anticipated from an extension of drilling activity in the Los Angeles Harbor area. The immediate result was that the plant efficiency was much lower than desired.

A choice of two methods for expanding extraction facilities was offered to cope with this problem: (1) building a new conventional absorption unit, or (2) installing a propane refrigeration unit. The compelling factor responsible for selecting the propane chilling method was that immediate results could be obtained with a minimum of changes to existing equipment, and a greater quantity of the lower boiling fractions could be extracted after the peak of flush gas production had passed.

It was calculated that the desired results would be obtained by chilling both the absorption oil and the raw gasoline. Therefore when the original unit as installed in January, 1947, was laid out, provisions were included to permit an increase in refrigeration, especially for the absorption oil. Piping, valves, and handling equipment were of sufficient capacity so that a second oil chiller could be later installed without repiping the entire unit. All that remained to be done was to mount the unit in its cradle and connect the various lines.

Wilmington engineers believed that further lowering of lean oil temperature would enable the plant to process a still greater volume of wet gas efficiently without increasing materially the oil circulation. In addition, lowering the chilling temperature of both the absorption oil and the raw "make" would provide a tangible increase in propane and butane production while a profitable market demand existed for these products.

The chilling plant proper, including the refrigerating interchangers only, occupies a relatively small area. It is built in a space 25 by 35 ft., near the plant pump and control room, convenient for operators to check and observe its functioning when necessary.

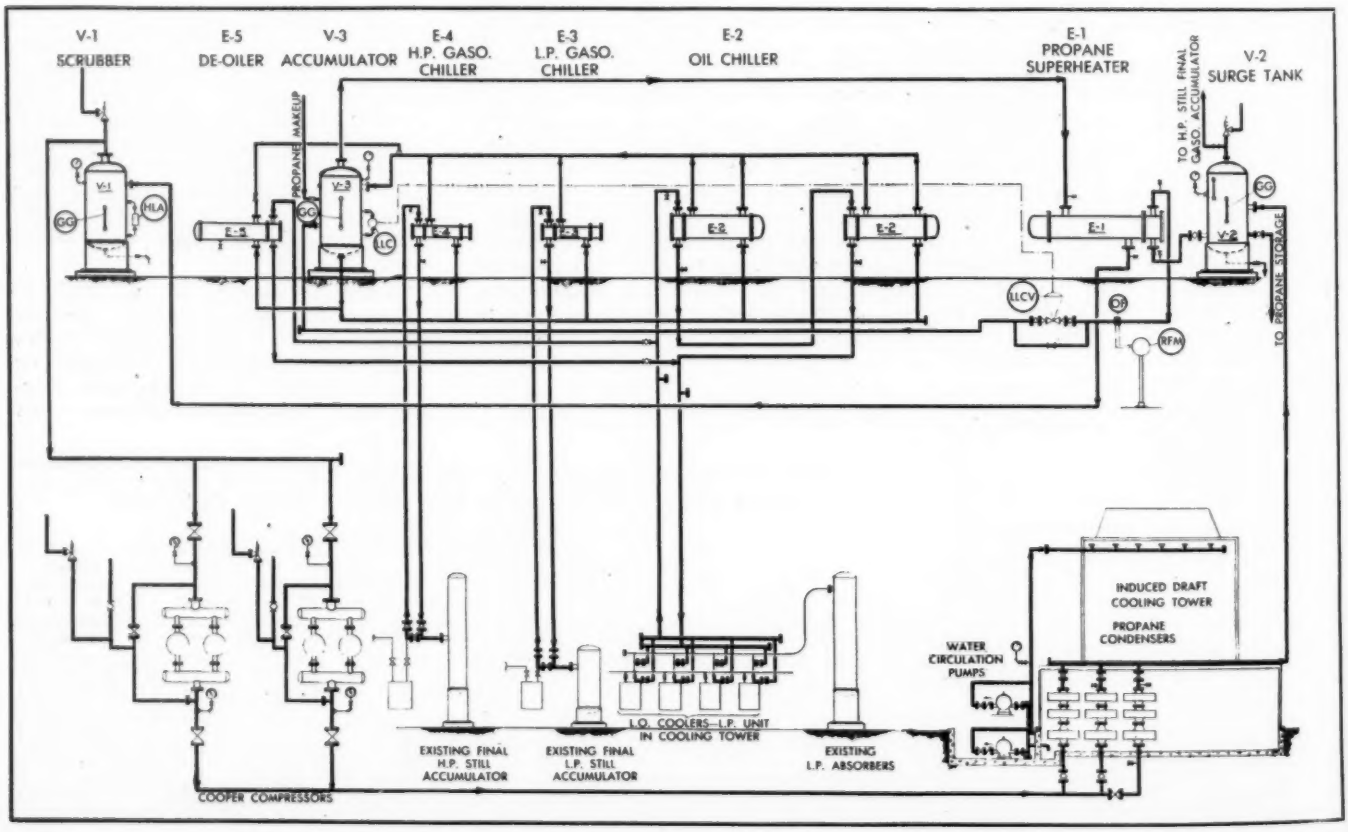
Two existing, horizontal, twin gas engine-driven compressors in the main engine room were set aside and equipped with cylinders, piping, etc. to handle the propane vapors in the chilling system. The compressor discharge of these vapors passes into nine admiralty tube, atmospheric condensers, each having 596 sq. ft. of transfer area and operating under a heat load of 5 million Btu./hr.

Propane vapors under compression enter these condensers at an average temperature of 110° F., and liquid propane is discharged at about 90° F., condensed by spray water with a mist temperature of 80° F., and draining from the tubes at 87° F. (See flow diagram, Fig. 1.)

For all practical purposes total condensation is obtained with liquid received in an accumulator-surge tank (Vessel V-2 in Fig. 1). From

Fig. 1—Flow diagram of Wilmington Gasoline Co.'s propane refrigeration unit. Instrumentation is indicated by following symbols:

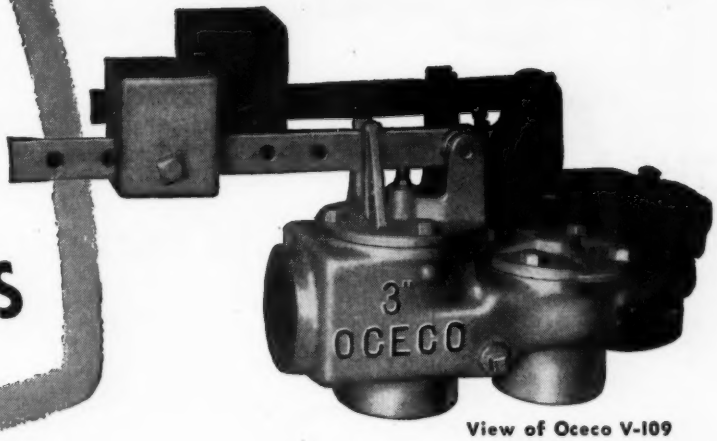
HLA—High level magneto short
LLC—Liquid level controller
OF—Orifice flange-flange taps
RFM—Recording flow meter (flow and static pressure)
LLCV—Liquid level control valve
GG—Gage glass



View of Oceco V-103
Vacuum Relief Valve.

View of Oceco V-106
Pressure Relief Valve.

OCECO
V-103; V-106 and V-109 VALVES



View of Oceco V-109
Combined Vacuum and
Pressure Relief Valve.

provide positive protection against excessive vacuum and pressure

● Oceco V-103, V-106 and V-109 Relief Valves are efficient, highly dependable and moderate in price. They require little or no maintenance, and reflect in every detail the advantage of our long and intimate experience with the needs of practical every day operations.

The V-103 Vacuum Relief Valves and V-106 Pressure Relief Valves are furnished in 3" x 3", 4" x 4", and 6" x 6" sizes, and are designed for temperatures up to 600°F. They can be used singly, or in pairs when it is desired to protect the tank or vessel against the effects of both vacuum and pressure. Standard setting for the V-103 Valves is 4 oz. per sq. inch but settings from 1½ oz. to 1 lb. per sq. inch can be furnished on special order.

The V-106 Pressure Relief Valves are of lever and weight design, and can be furnished with pressure settings from 2 lbs. to 30 lbs. per sq. inch to meet the individual requirement.

The V-106 Valve combines vacuum and pressure relief in a single body, and eliminates the necessity of using two valves when both pressure and vacuum relief is required. Furnished in 3"; 4"; 6" and 8" sizes. Wide range of vacuum and pressure settings.

Complete details including prices, body and trim specifications etc. furnished promptly on request.

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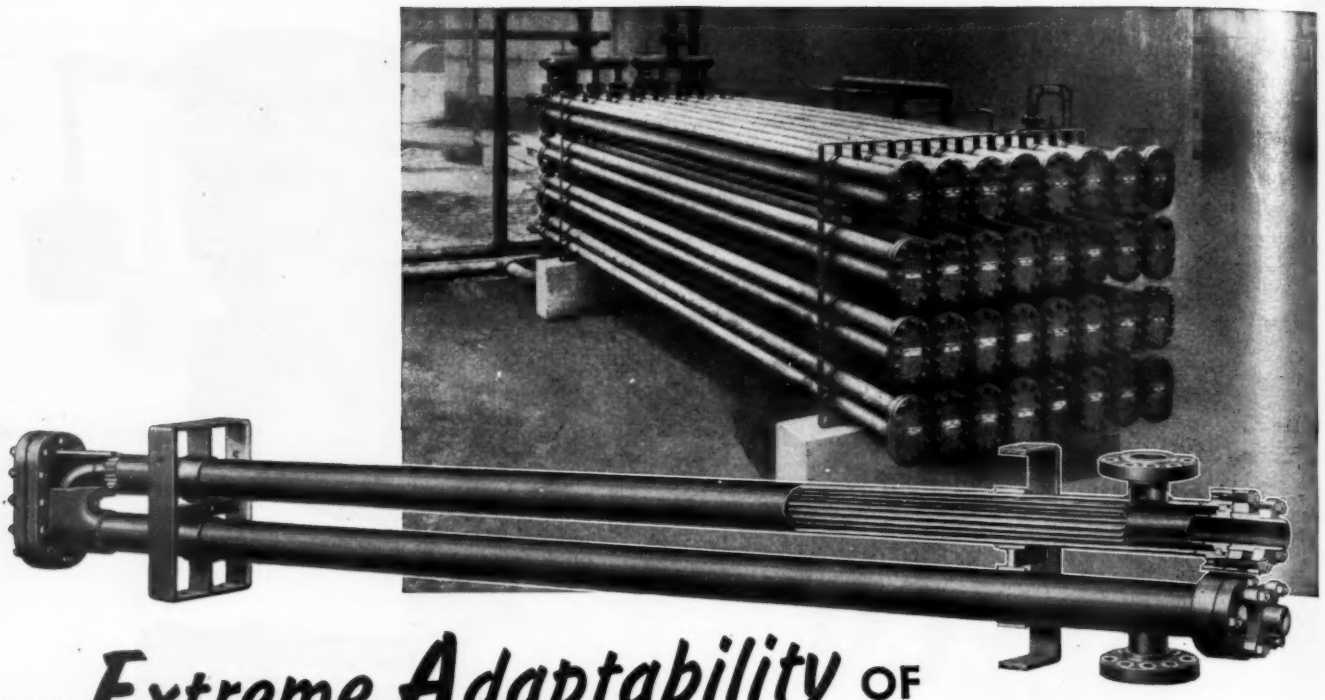

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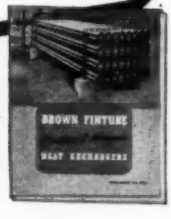

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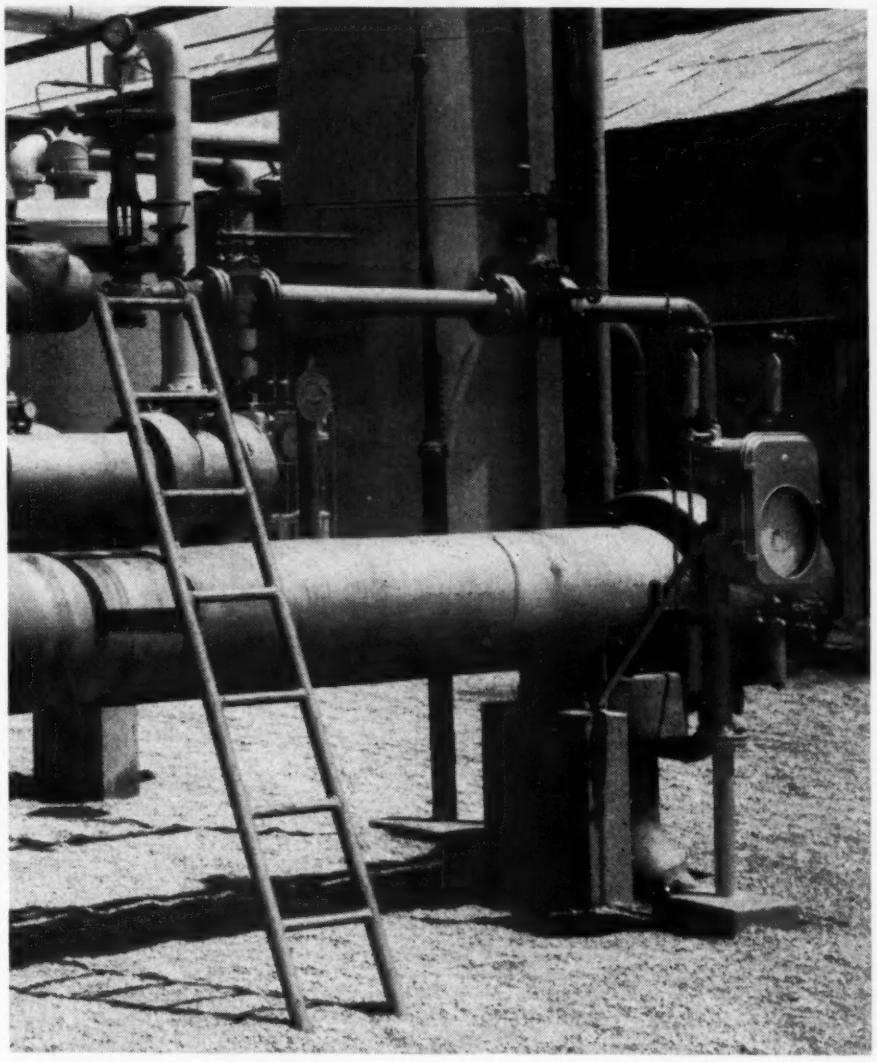


Operators watch few control instruments on Wilmington's new propane refrigeration unit. Meter at extreme right records liquid propane circulation rate. Permanent ladder reaches valves which control liquid level in the accumulator vessel

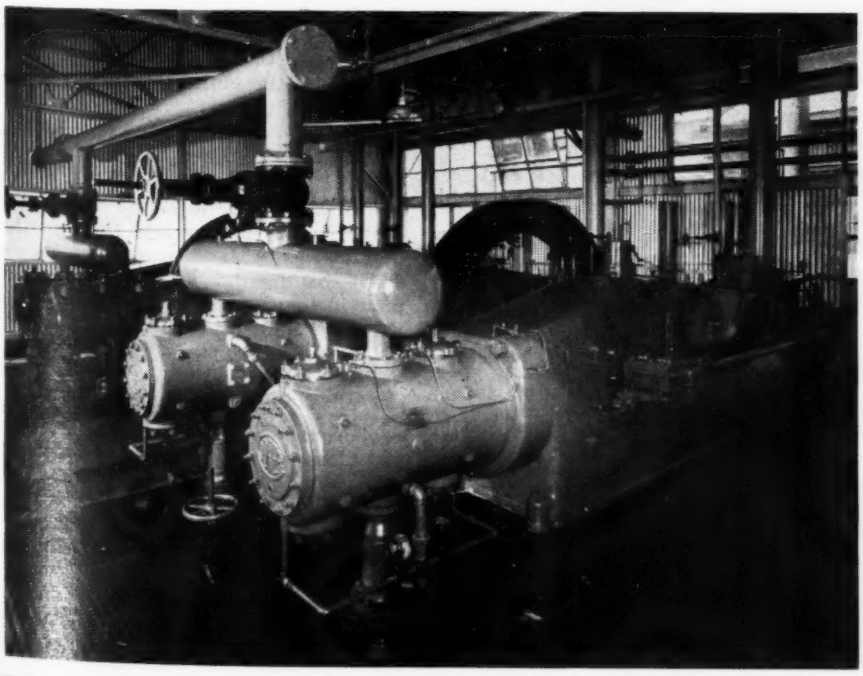
this point, entrained ethane is bled into the plant gas system through a hand-operated block valve, which may or may not be left opened a "hair". The usual procedure is to bleed off a small quantity of vapors from the surge tank once each hour. The surge tank measures 42 in. by 6 ft., and is equipped with the necessary safety valves and a dump line through which propane can be transferred to storage if required to vent the system.

Because the liquid propane in the surge tank is at an average temperature of 90° F., it is desirable from a refrigerating standpoint to reduce this temperature as low as practicable. Therefore, the liquid flows from the surge tank through a 3-in. line directly to a propane superheater for interchange with vapors flowing from the chillers back to the compressors.

Superheater E-1 is a shell and tube unit containing 301 sq. ft. of transfer area and working under a heat load of 74,500 Btu./hr. The hot propane enters at 90° F. and leaves at 85° F.; the cold propane vapors enter at 45° F. and pass to the compressor intake system at 50° F.

From the superheater, the liquid refrigerant flows through a 3-in. line to the midsection of the propane accumulator, V-3, which also measures 42 in. by 6 ft., and is completely insulated. In this 3-in. transfer line is the only instrument requiring attention by the plant operators. It is a remote liquid level control valve actuated by an instrument on the side of accumulator V-3; it maintains an accurate predetermined level in the accumulator and in turn provides the required submergence level of liquid propane on the chilling tubes.

All chillers, for both lean absorption oil and raw plant gasoline, are set on concrete piers to provide a common level so that each chiller will receive its share of propane and so that all tubes in each chiller will be under similar flooding with liquid propane. To reduce the temperature of the lean, low pressure absorption oil, the material is first cooled in conventional atmospheric coils in a water cooling tower, and then passed on to the chillers, vessels E-2. Two of these units are now in operation; the first was installed in January and the second in August, 1947. Each



Two Cooper, Type 80, compressors—existing equipment in Wilmington's compressor house—were utilized for compressing propane for the new refrigeration unit

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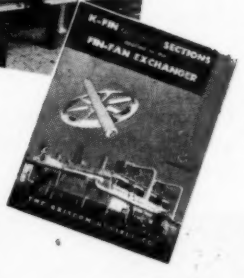

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one contains 1800 sq. ft. of transfer area, and they are operated in series flow. Oil enters the chillers at 85° F., and passes into the piping leading to the absorbers at 60° F. The heat load of these chillers is 3,910,000 Btu./hr.

Two similar chillers, E-3 and E-4, but of different capacities, are employed to effect a reduction in the temperature of two gasoline streams. Gasoline condensed from the low pressure distillation section flows from the conventional condensers through chiller E-3, which has a transfer area of 346 sq. ft. and operates under a heat load of 530,000 Btu./hr. Condensate from the stills, together with uncondensed gasoline and fixed vapors, enter the chiller at 82° F. and are passed on to the stabilizer surge tank at 60° F.

The chiller E-4 for the high pressure section likewise reduces the condensate from 82° to 60° F. This chiller has 250 sq. ft. of transfer area and is operated under a heat load of 335,000 Btu./hr.

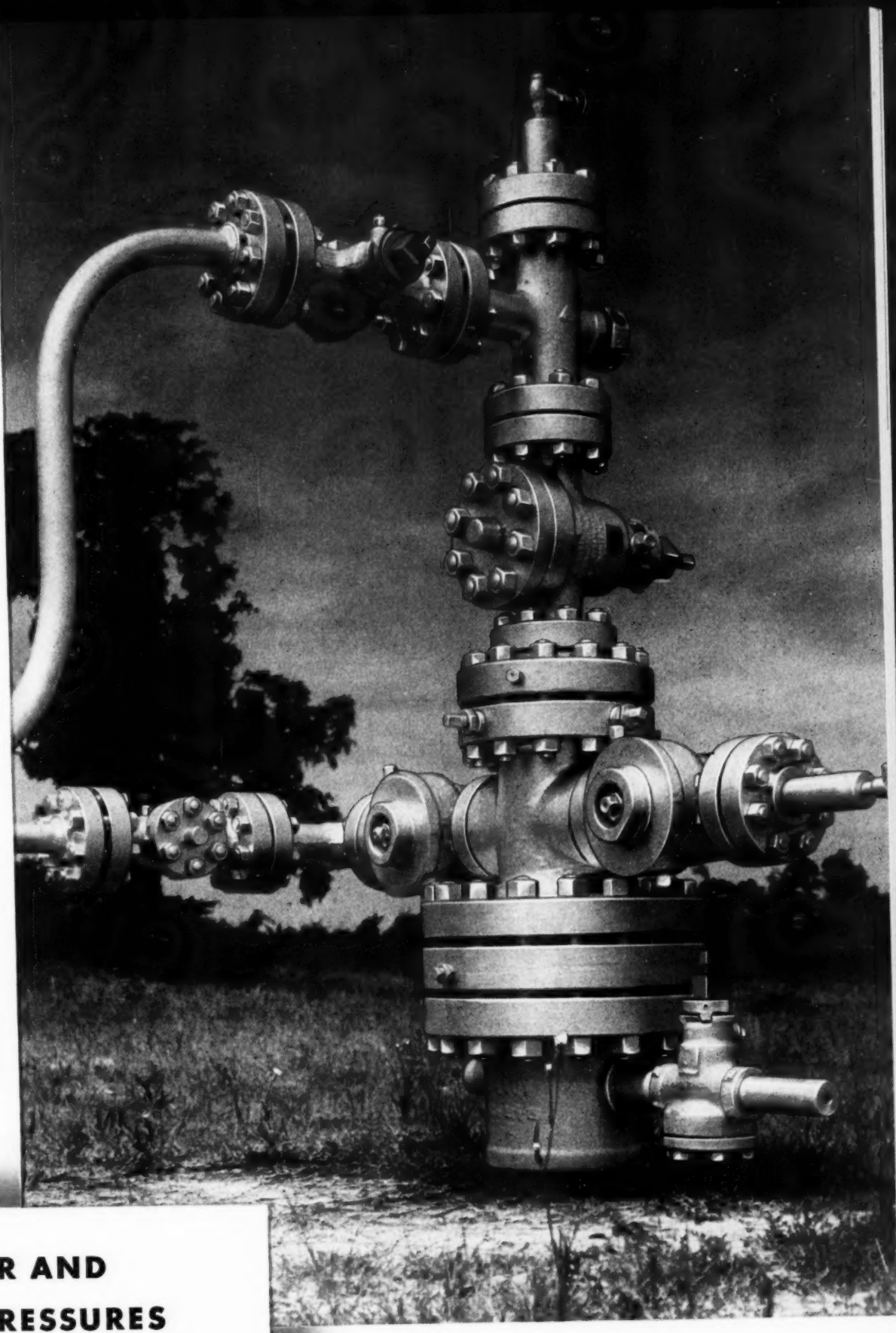
All evaporated propane from the chillers passes back to accumulator V-3. This method is followed so that the system will be under a balanced pressure load, and to eliminate the need for more than one vessel. This accumulator scrubs the evaporated propane to remove any liquid particles before being trapped in the compressor intake scrubber, V-1.

Since the compressor cylinders are equipped with force feed lubricators, excess oil is carried with the propane into the liquid stream. This is removed by bleeding a small stream of propane from the bottom of each chiller shell into a common manifold line. Connections are made at each end of all chillers so that an accumulation will not occur at points of low turbulence. This stream of oil-laden propane passes to the de-oiler section, E-5, set at a lower level than the chiller shells, for gravity feed.

For evaporation of the propane from the oil at this point, a split stream of lean absorption oil is taken from the main feed line to the oil chillers E-2, and passed through the de-oiler as a heat medium. Vapors from the de-oiler flow into the common header which carries all evaporated propane to the accumulator, while the absorption oil joins the main stream and flows on through the oil chillers to the absorbers.

There are only two controls that plant operators need be concerned with, outside the engine room: (1) the drain valve in the de-oiler to dump the occasional small accumulation of lubricating oil, and (2) the motor valve on the 3-in. transfer line from surge tank V-2 to accumulator V-3, to adjust the level in the chiller shells.

The safest valves for trees of steel



On this modern Christmas tree main valves are Nordstrom Hypreseals, bleeder valves are Edward gage valves; both Rockwell-built.

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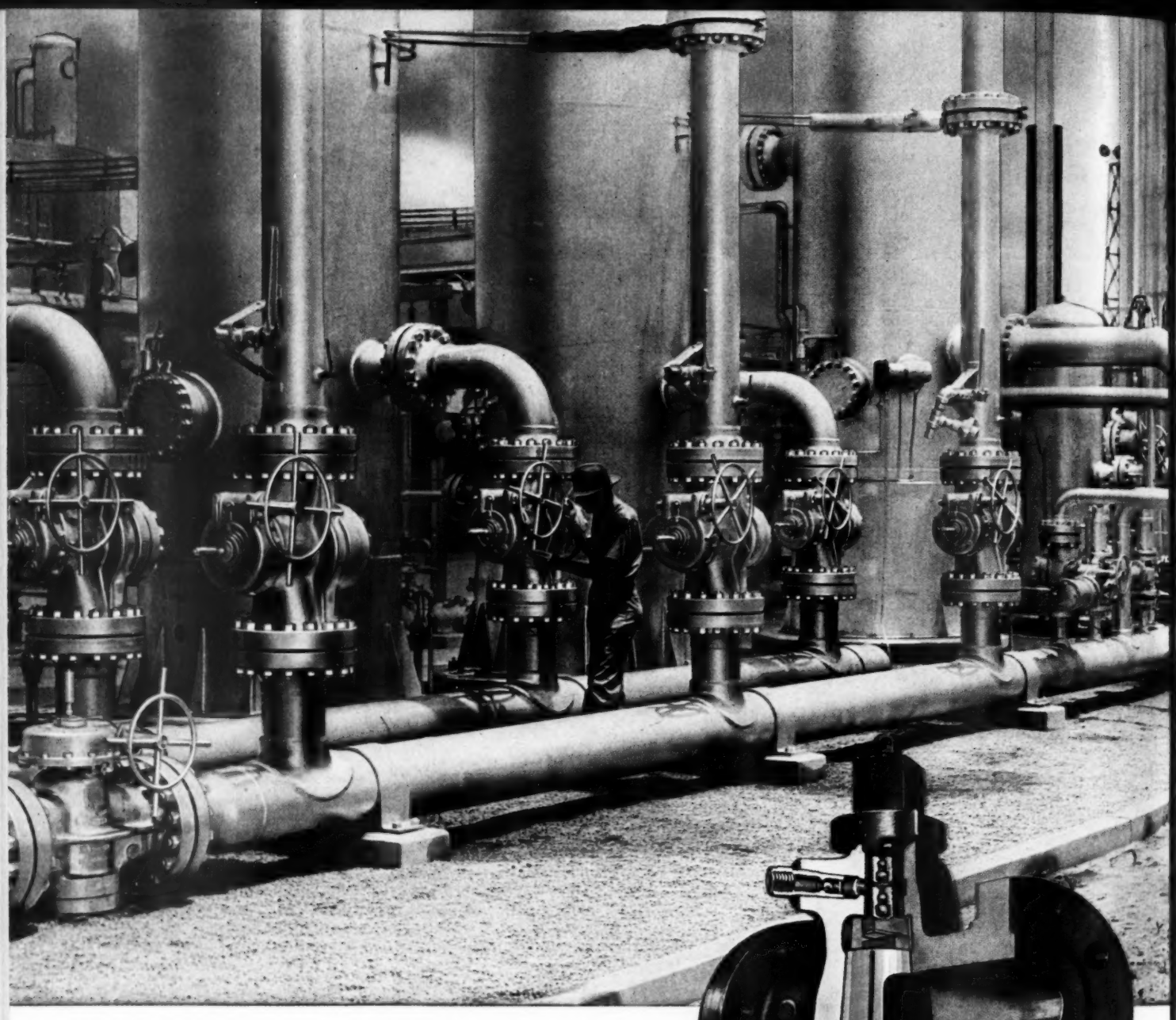

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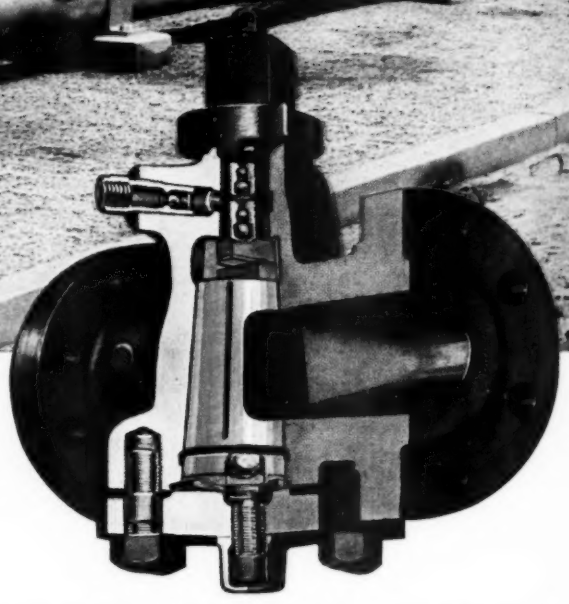

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Design and Construction of

PRESSURE RELIEVING SYSTEMS

By NELS E. SYLVANDER and DONALD L. KATZ

In this, the third and concluding article in a series dealing with the principles and methods of providing pressure relief for refinery equipment, the authors discuss the safe disposal of fluids leaving relief devices and the depressuring and emptying of equipment.

The first article (July, 1948, pg. 642) dealt with the causes of excessive pressure in refinery vessels and compared various methods for determining what relief capacity should be provided. The second article (August, 1948, pg. 774) discussed the relief area needed for a given capacity, the various types of relief devices which can be used, and their proper location and mounting.

The entire series is based on an API research project carried on at the University of Michigan, and has been written for *Petroleum Processing* by the two men who conducted the study and prepared the complete report on the project.*

Safe Disposal of Fluids Leaving Relief Devices

The protection of plant personnel and plant equipment requires that safety precautions be taken in disposing of fluids which may be injurious upon contact or which may ignite. Unless discharged fluids are safely disposed of, consequential damage as serious as may have resulted from failure to release overpressure in a vessel can occur.

The degree of hazard from relief device discharge varies considerably depending on the nature of the fluid and the surroundings. Hydrocarbons and gases lighter than or as dense as air can usually be safely vented directly to the atmosphere if the venting occurs at sufficiently high elevations. Hydrocarbon vapors heavier than air but which normally exist in the gaseous state may be vented directly to the atmosphere with safety if the venting occurs at an elevation which permits the vapors to diffuse into the atmosphere beyond the lower limit of combustibility prior to reaching any ignition source. Heavy hydrocarbon vapors which normally condense at atmospheric conditions have been released directly to the atmosphere. Generally speaking, these heavy vapors have been vented successfully but occasionally they have flashed, resulting in burning droplets spreading the fire. In any case, there is the possible hazard to personnel from contact with hot oil.

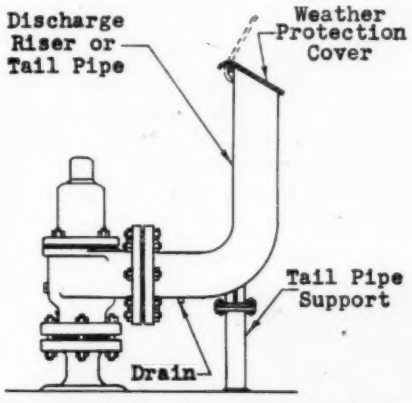


Fig. 16—Relief valve installation for locational venting

Corrosive and toxic fluids cannot be safely released directly to the atmosphere. Any accumulation of hydrocarbon liquid is recognized as a potential fire hazard, and released hydrocarbon liquid from relief devices should be removed through a collector system to some disposal point. Stable hydrocarbon liquids may be safely discharged into sewer lines leading to an oil separator.

Direct Venting to the Atmosphere

Direct venting to the atmosphere may be satisfactory for some of the valves in plants which are located in a relatively far-removed area from homes or industrial concerns. If a reasonable degree of uncertainty exists concerning direct venting on any vessel or unit, a thorough analysis should be made of the possible results and hazard during a period of maximum fluid release.

The conventional relief valve is generally mounted in a vertical position with the valve outlet in a horizontal direction. The release of fluids in a horizontal direction is only advisable if the device is either at a considerably higher elevation than any surrounding equipment or is quite removed from any surrounding equipment. The preferable installation for local venting of vapor is to direct the stream upward as illustrated in Fig. 16. The height of the discharge riser should be sufficient to release the fluid at least 10 ft above any platform within a 25 to 30 ft radius. The discharge pipe should be sufficiently large so as to have no adverse effect on the capacity of the relief device.

Water should not be permitted to accumulate in the discharge piping and in the discharge side of relief devices. A weather protection cover, if used, should be free to open readily and should be of light gauge metal so that rupture will occur should the opening be hindered in any way.

Relief devices which discharge liquid should have a short piping-run to a convenient sewer or ground location. The discharge line should be sized for a pressure drop in keeping with the backpressure allowance made in calculating the relief device area. If the liquid released is in a saturated or compressed state, locational venting to a sewer or ground location is not recommended unless the vaporizing liquid does not present a fire hazard.

Venting or Collecting Systems For Fluid Relief

Many pressure vessels and plant operating units require that fluid released from pressure relief appliances be removed to a safer point for

THE AUTHORS

Nels E. Sylvander was research engineer, Engineering Research Institute, University of Michigan, Ann Arbor, at the time this series was prepared. He has since become associated with the Research and Development Division of Pittsburgh Consolidation Coal Co. Donald L. Katz is Professor of Chemical Engineering, Department of Chemical and Metallurgical Engineering, University of Michigan.

* "Design and Construction of Pressure Relieving Systems," Engineering Research Institute Bulletin No. 31, University of Michigan Press, 311 Maynard St., Ann Arbor, Mich. Available at $3 per copy.

disposal. When the required capacity is known, the permissible backpressure for this capacity must be determined to complete the design for the overall line length of the collector system. Pressure in a collector system has four effects on relief appliances:

1. It may tend to decrease the flow rate through a relief device.

2. It may interfere with relief valve action by either preventing the valve from going to the wide-open position or by causing premature closing.

3. It may prevent relief valves not in operation from opening, even with excessive pressures below the relief device.

4. It may cause a relief valve with the bonnet vented to open when the pressure beneath the relief valve is normal.

The full effect of backpressure on spring-loaded relief valves is not known. It is hoped that industry will be provided with definite data to be used in design and also that relief valves will be modified to permit higher backpressures with no adverse effect on the operation or flow rate.

A collector system which serves many relief devices may never require capacity equal to the combined total of all the relief devices. A careful analysis of the causes of overpressure should be made; and where it is readily apparent that a group of relief devices could operate simultaneously, capacity should be provided for this rate of flow. For causes which are considerably remote but do not involve fire exposure, capacity should be provided so that excessive pressure cannot exist for an extended period. Frequently, the process is so designed that the operation of one relief device removes sufficient material from the system so that in a short time a downstream relief device will be called on to discharge less fluid.

If the maximum collector capacity is needed for fire involvement, it becomes necessary to analyze the unit lay-out and determine the probable fire area. The collector line capacity should then be provided equal to the combined capacity of the relief devices on the equipment involved.

The large sizes of collector lines installed in modern plants when using a backpressure at the relief device not exceeding 10% of the set pressure makes it apparent that valve design permitting higher backpressure should be developed.

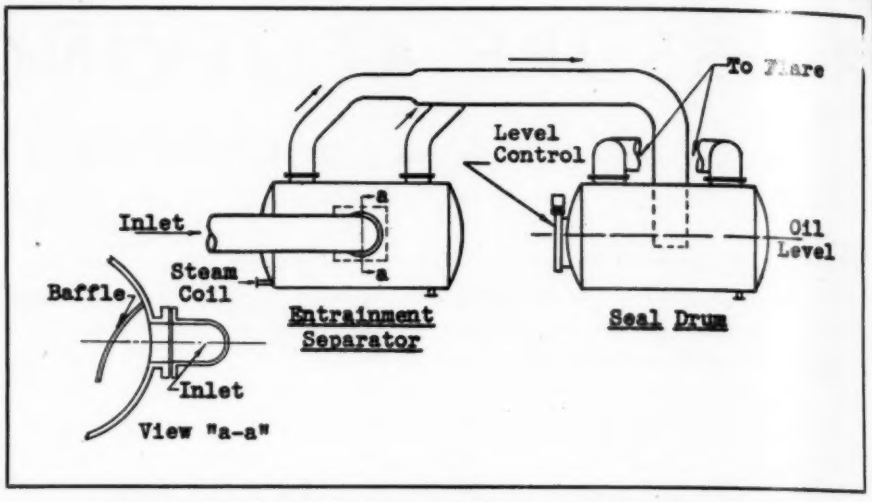
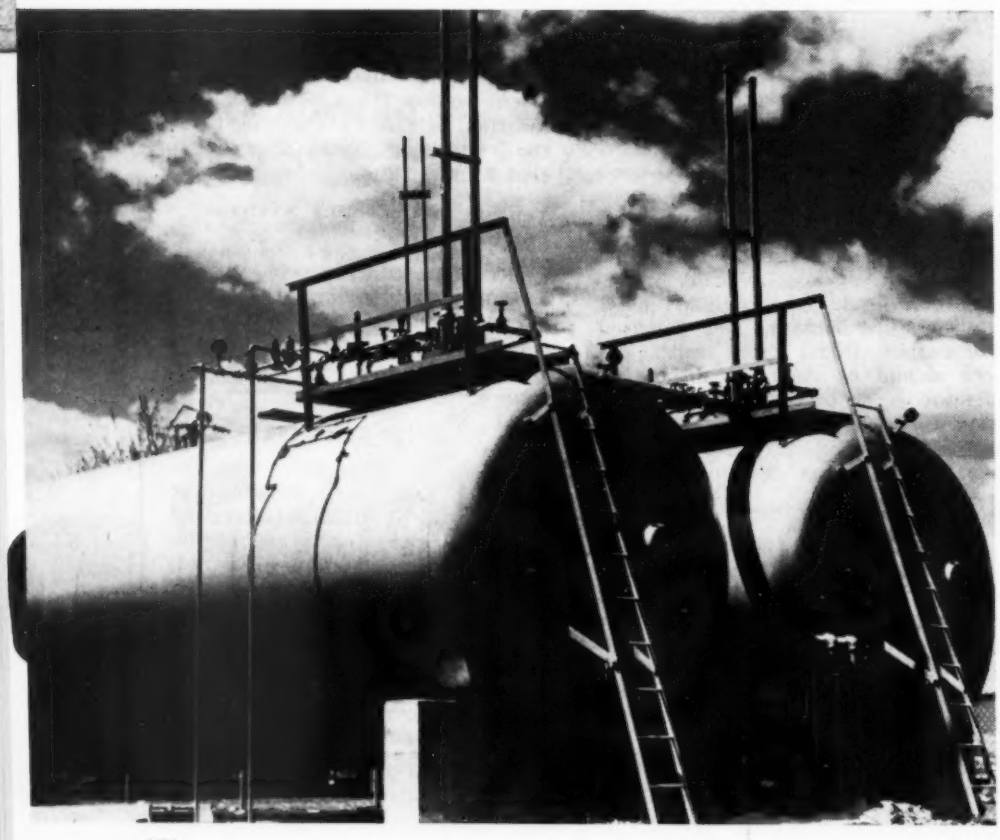


Fig. 17—An oil seal drum preceded by an entrainment separator

A typical relief valve installation on storage tanks of Phillips Petroleum Corp., showing the method of venting the discharge through vertical risers terminating about 10 ft. above the tanks. Each riser is topped with a light, metal rain cap with a loose fit, which is easily blown off if the relief valve operates. Its purpose is to protect the top of the relief valve from rain and snow which might otherwise accumulate

Photo Courtesy Phillips Petroleum Co.



Relief System Disposal Units

Released vapors may be disposed of by permitting them to diffuse into the atmosphere or by burning in a ground pit or at the top of an elevated flare stack. Heavy petroleum vapors may be condensed for recovery and light vapor can occasionally be recovered as a gas in large low-pressure holders.

The open burn pit with a small pilot flame, requires a minimum amount of design unless local ordinances against smoke are in effect or if shields are necessary to keep the flame from going in certain directions. One company has developed a program to eliminate objectionable smoke from the disposal of waste light hydrocarbon gases using a spe-

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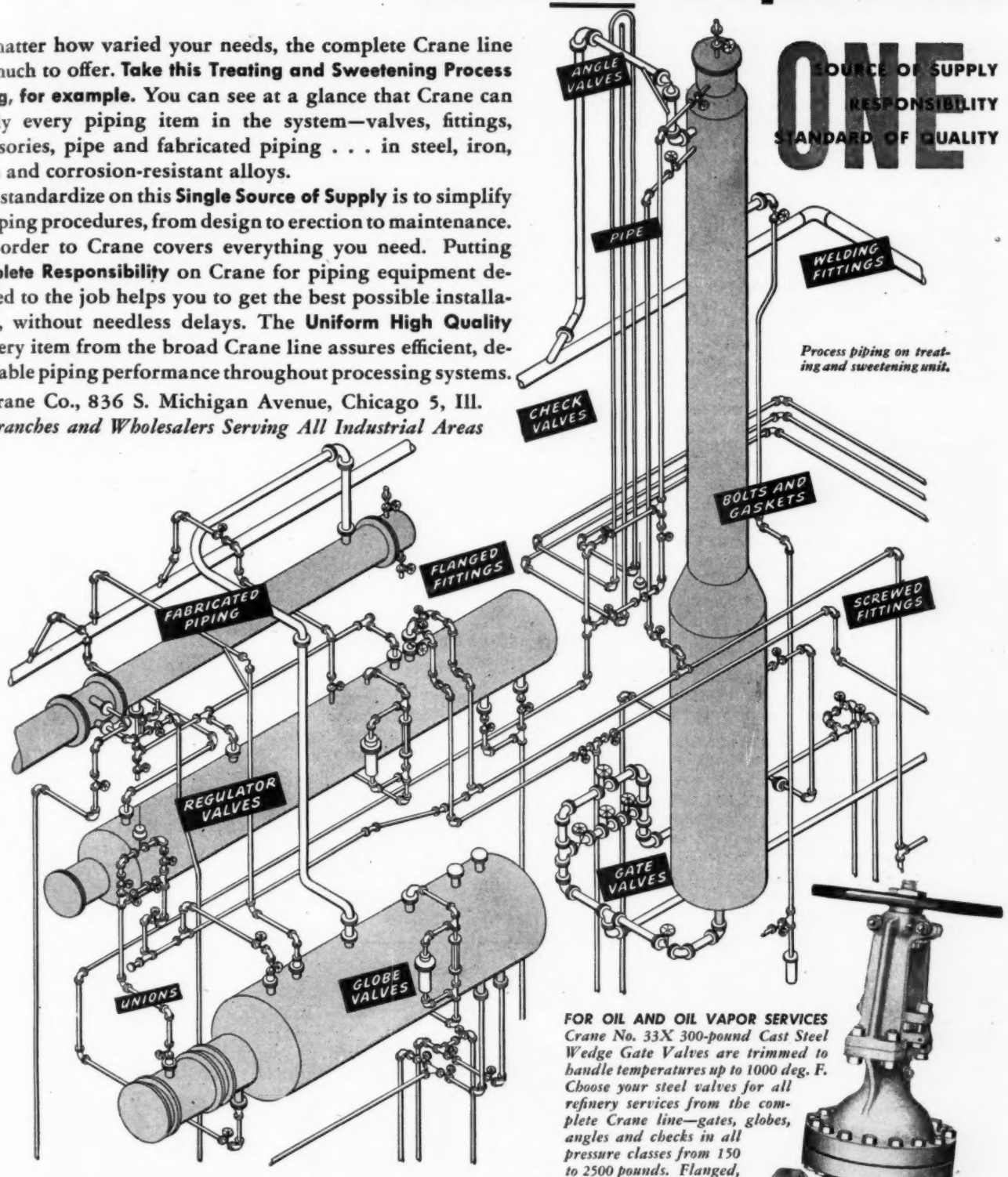

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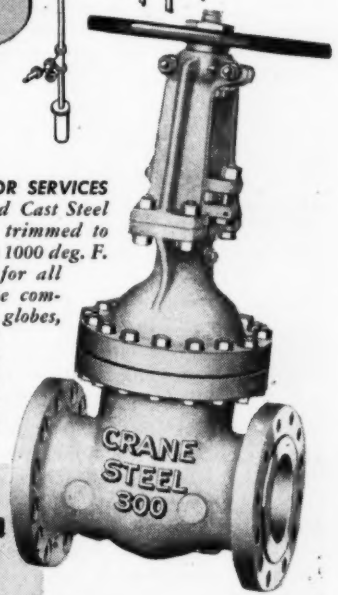

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cifically designed installation of venturi-type aspirating burners*.

Many plants do not have an area suitable for burn pits and are required to construct elevated flare stacks occasionally as high as 200 ft and of a diameter up to 36 or 40 in. Where flare stacks are used, provisions should be made to remove any condensed hydrocarbon prior to the flare, and also a seal drum or flame arrestor should be installed between any knockout drum and flare stack to eliminate possible flash-backs.

Knock-out drums or velocity-breaking drums should be large enough to give a velocity low enough for condensate removal. The angle of entrance of fluid into the drum is important to aid in the removal of entrained liquid and most companies have their own special designs.

Seal drums need only be large enough to permit the flow of the desired quantity of vapor within the pressure drop allowed. Water seals are advisable where freezing is not a ready possibility and where the released fluid does not become corrosive in the presence of water. In freezing locations and for corrosive fluids, a light oil of low viscosity is advisable. The height of the liquid seal above the open end of the inlet pipe should not permit back-up into the inlet lines beyond any point where pressure build-up might occur. A typical seal drum with an entrainment separator is shown as Fig. 17.

Vapor containing a corrosive gas can be neutralized prior to disposal in a contact scrubbing column. This same scrubbing column can be used to reclaim liquid or vapor release which contains solutions for treating or processing. To reclaim a water-soluble treating medium, the circulated scrubbing solution would be water and the material being recovered.

Vent or flare stacks when used should be designed so that liquid can drain back into the seal drum. The stack height will depend on the location and the surrounding equipment. The top of the stack should be considerably above any equipment within a radius of several hundred feet. Stacks should not necessarily be oversized as eddy currents and low velocity may permit flame travel or flash-back to the base of the stack.

Liquid and heavy vapor should be relieved to a large blow-down drum, such as in Fig. 18, which will permit liquid to be salvaged either by pumping to recovery or by overflow to waste oil separators. The heavy vapor is generally at a comparatively high temperature and should be let off from the blow-down drum to a quench tower where a considerable portion of the heavy vapor may be condensed for recovery and the uncondensed vapor vented to either the atmosphere or through a liquid seal to a flare. Frequently the blow-down drum used for liquids and heavy vapor is the blow-down or steaming-out drum used in pumping out units for inspection and maintenance.

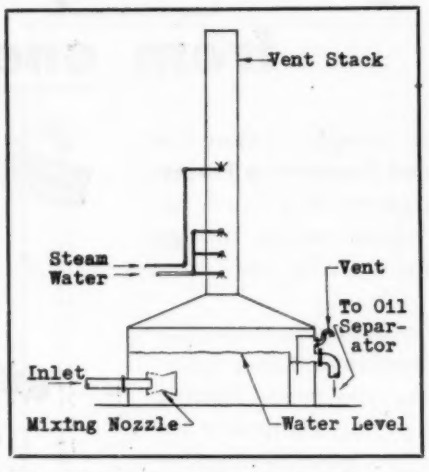

Fig. 18—Fluid release tank and vent, sectional view

Depressuring and Emptying Of Equipment

Manually - operated dropout valves can allow the entire contents of a vessel to be conveniently removed in a relatively short interval. Several companies consider the use of dropout valves and depressuring lines as essential in any program which attempts to provide protection against vessel failure during fire. Such systems require a disposal means which can handle large quantities of liquid and/or vapor. Systems similar to that used for handling relief valve release are suitable. It may not be advisable to have one disposal system serve both relief valve release and depressuring lines. If the same disposal plant is used, careful consideration should be given to any possible effect on the pressure relief design. Rapid depressuring of equipment lessens the possibility of failure with explosive violence and may permit vessels to survive a severe fire if the internal pressure can be reduced to near atmospheric.

Equipment which operates at relatively low pressure can be displaced with water, and in several plants water displacement of the contained fluid serves to remove hydrocarbons from a possible fire area and at the same time provides internal cooling for the shell metal.

A typical depressuring arrangement is shown in Fig. 19. Depressuring systems are only advantageous if they can be operated from locations safely removed from dangerous areas. This has been accomplished by having long lines from the protected vessel to a remotely-located station. A block valve at the vessel on this line is sealed or locked open while the block valve at the station is closed.

Although pressure relieving systems may be adequately designed, they may not give the intended relief protection unless a planned inspection and maintenance program is in force. An API committee is preparing an inspector's manual which will include a section on pressure relief devices. Good housekeeping is a partner to inspection and maintenance and tends to lessen the probability of emergencies requiring pressure relief.

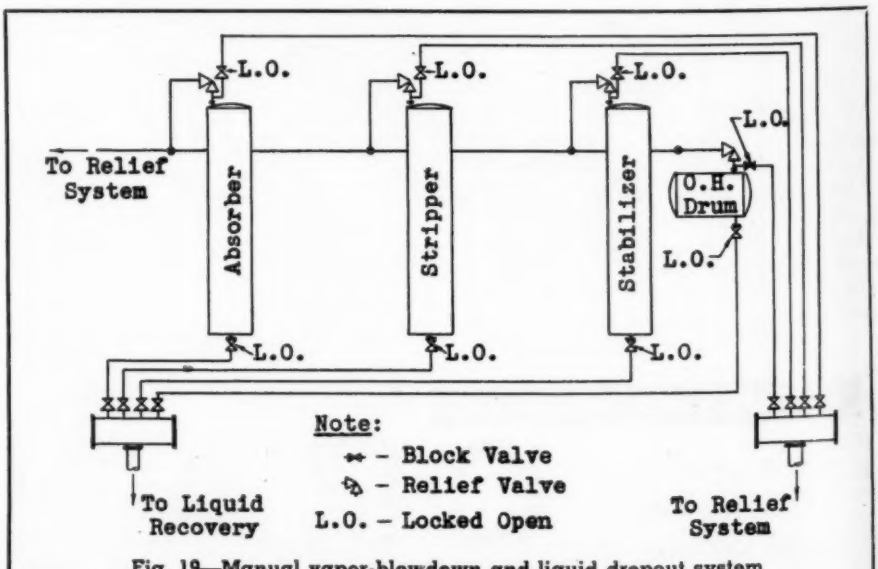

Fig. 19—Manual vapor-blowdown and liquid dropout system

*Brumbaugh, A. K., PETROLEUM PROCESSING, 2: 3, 168 (1947).

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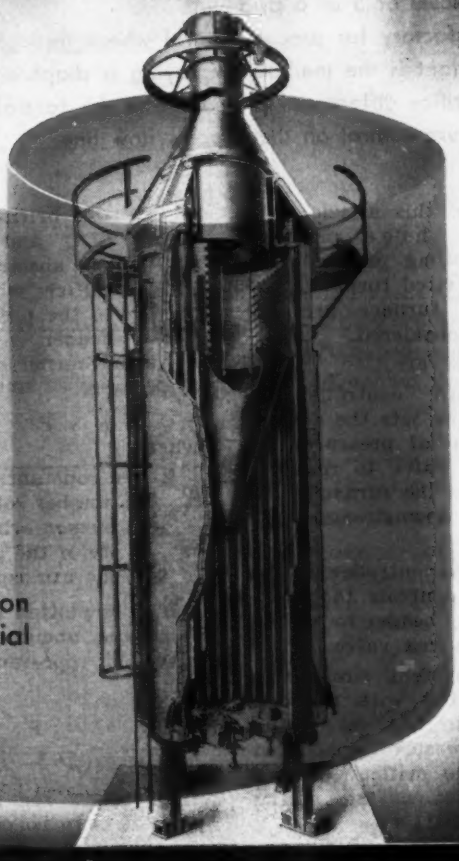

Each bank of tubes (each pass) is equi-distant from the flame.

●

Each bank of tubes (each pass) is exposed to the same heat intensity.

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Length of fluid travel for each pass (including crossovers) is identical from inlet to outlet.

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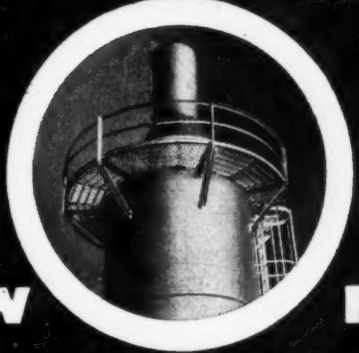

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Comparison of Systems for Controlling Gas-fired Furnace Process Temperature

By HAROLD E. McCLATCHEY, Foster Wheeler Corp.

In describing typical examples of three methods for controlling process temperatures in a gas-fired furnace, the author shows that use of a so-called "pressure balanced" control valve is most practical because of low first cost and low maintenance. The method, however, requires variations in process demand of under 25%, and burner header pressures in excess of 5 or 6 psig.

Most satisfactory for precise control where throughput is relatively high and constant is the method employing a diaphragm control valve actuated by orifice differential pressure with the control point being set by a temperature control on the process flow line.

THE purpose of this article is to compare the three principal methods of controlling process temperature in a gas fired furnace. Air-to-fuel ratio and furnace pressure control are not considered.

The three methods are:

1—A temperature controller on the process flow line sets the control point of a differential pressure-controlled diaphragm valve to regulate flow of fuel gas to the furnace. The orifice is located downstream from the valve.

2—A temperature controller on the process flow line controls the pressure on the fuel gas header by means of a pressure balanced valve.

3—A cascade system similar to the first method, but with the orifice upstream from the valve, and an additional pressure controlled valve ahead of the orifice to keep the fuel gas pressure constant at the orifice.

A comparison will be made by exemplary cases as follows:

Case I

This case is an example of Method 1 and is depicted in Fig. 1. A cascade system is shown with a temperature controller, "TC", and a differential pressure controller, "DC". It will be noted that the orifice is downstream from the control valve.

The equation for flow at the orifice, in standard volume units per unit of time, is:

$$Q = k_1 \sqrt{hP} \quad \ldots\ldots (1)$$

where:

Q = flow,

k_1 = a constant depending upon the size of the orifice, pipe size, specific gravity, etc.,

h = the differential pressure across the orifice as controlled by "DC" and set by "TC,"

P = the absolute pressure at the orifice, which is nearly equal to the pressure at the burner header.

At the burner header, the equation for flow is:

$$Q = k_2 \sqrt{P^2 - A^2} \quad \ldots\ldots (2)$$

where:

k_2 = a constant depending upon the number of burners, size of burner orifices, specific gravity of the gas, etc.,

A = the atmospheric pressure.

If Q is plotted as the ordinate and P as the abcissa, the slope of the curve is represented by the equation:

$$\frac{dQ}{dP} = \frac{P}{\sqrt{P^2 - A^2}} \quad \ldots\ldots (3)$$

At values for P of less than 20 psia., it is to be noted that the slope varies rapidly, and for large values of P the slope is nearly constant.

By allowing:

$$k_1 \sqrt{hP} = k_2 \sqrt{P^2 - A^2}$$

Q may be solved for terms of h only:

$$Q = \sqrt{\frac{k_1^2 h}{2}\left(\frac{k_1^2 h}{k_2^2} + \sqrt{\frac{k_1^4 h^2}{k_2^4} + 4A^2}\right)} \quad \ldots\ldots (4)$$

By referring to Equations 1, 2 and 3 for large values of P:

$$Q \cong \frac{k_1^2}{k_2} h$$

The curve for Q versus H is shown in Fig. 2.

If the fuel gas supply pressure should vary, the "DC" controller acts to hold Q constant and therefore the pressure P constant. For reasonably slow variations in supply pressure, no controller is required for the fuel gas supply pressure.

If one of the burners should become plugged or shut off, the "DC" controller actually increases the flow Q in the other three burners greater than it was originally. The "TC" controller would have to be depended upon to reduce the differential on "DC" so that the original flow may be had. Proof of the above is shown as follows.

Assume one burner becomes plugged: k_2 reduces to ¾ of its former value. Since the differential is held constant, the ratio of the two flows is 3-4. Thus let Q_1 equal initial conditions with all burners open, and Q_2 equal the conditions with three burners on, then:

$$\frac{Q_1}{Q_2} = \frac{k_1^2 h}{k_2} \Big/ \frac{k_1^2 h}{\frac{3}{4} k_2} = \frac{3}{4}$$

$$\frac{P_1}{P_2} = \frac{9}{16}$$

Trimming or plugging of burners with this system will tend to increase the temperature temporarily until the temperature controller resets the "DC." It is to be noted further that 40 to 50 pipe diameters, or straightening vanes, are required between the control valve and the orifice.

If the fuel gas specific gravity should vary, Q will vary inversely as the square root of the specific gravity. Since the Btu. value for hydrocarbon gases increases with specific gravity, some correction is to be had by holding h constant insofar as holding heat input constant is concerned with varying specific gravity.

Case II

This case is an example of Method 2 and is illustrated in Fig. 3. A system is depicted whereby a temperature controller, "TC," is controlling the pressure on the burner header by means of a pressure balanced valve. This system is equivalent to using the "TC" to set the control point of a pressure controller.

According to Equation 2, k_2 is assumed to be a constant. This is not exactly true, because it varies with the ratio of A to P. However, the

variation is small enough to be neglected for purposes of this comparison. The graph in Fig. 4 indicates a comparison between test results and the theoretically derived curve.

As can be seen from the curve in Fig. 5, and from Equation 3 for the slope; for values of P nearly atmospheric, Q changes rapidly for small changes in P. It is therefore not practical to control at pressures less than 5 or 6 psig. for large variations in process demand.

If one of the burners should become plugged or shut off, the flow Q would drop to ¾ of its original value. The "TC" controller would then have to be depended upon to increase flow Q to its original value.

As in Case I, this system compensates in part for variations in specific gravity on a Btu. input basis to the furnace.

Case III

This is an example of Method 3, and is illustrated in Fig. 5. As in Case I, a cascade system is depicted with the exception that the orifice is upstream from the "DC" control valve, and an additional controller is required to hold the gas pressure constant at the orifice.

The curve for Q versus h is shown in Fig. 6, and the equation is:

$$Q = k_2 \sqrt{h} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

If one of the burners should be shut off, in this case, the flow controller, "FC," tends to hold flow Q constant. It is to be noted that 40 to 50 pipe diameters, or straightening vanes, are again required be-

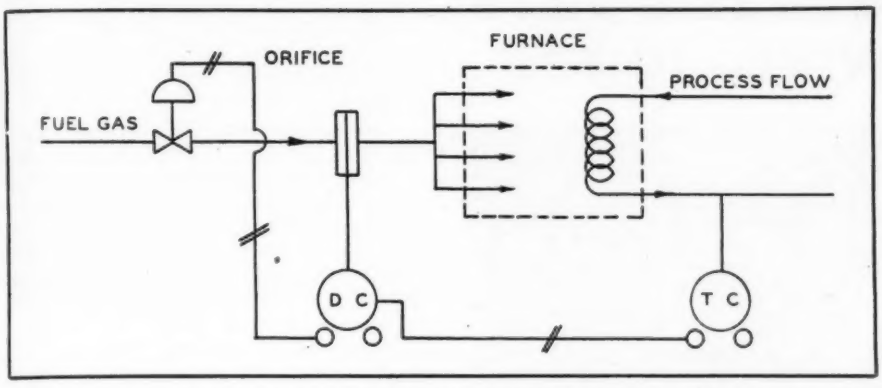

Fig. 1—Instrument arrangement for Case I; a cascade system with a temperature and a differential pressure controller and orifice downstream from valve

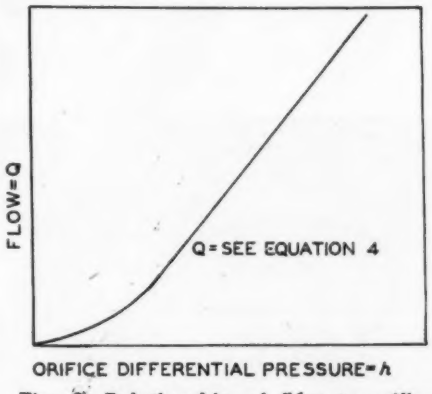

Fig. 2—Relationship of flow to orifice differential pressure in Case I

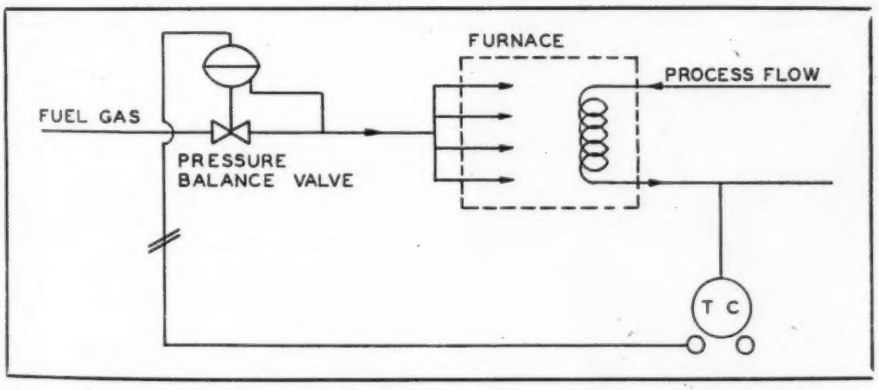

Fig. 3—Instrument arranagement for Case II; where a temperature controller regulates pressure on burner header by means of a pressure balanced valve

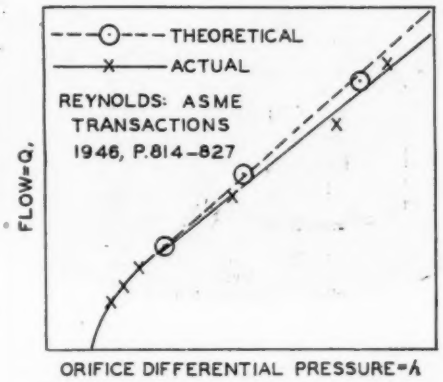

Fig. 4—Close agreement between actual and theoretical values for flow in Case II

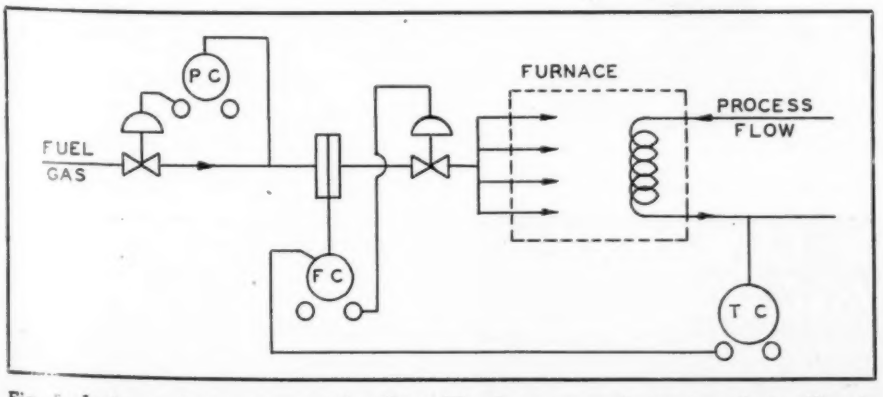

Fig. 5—Instrument arrangement for Case III; also a cascade system, but orifice is upstream from valve, gas pressure is held constant at orifice

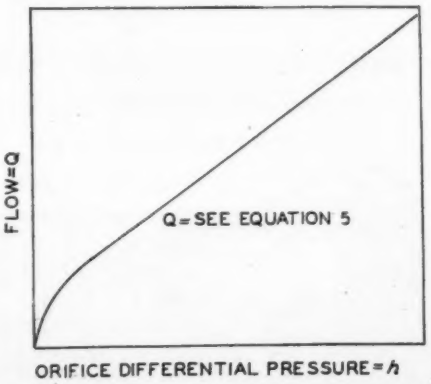

Fig. 6—Relationship of flow to orifice differential pressure in Case III

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tween the "PC" control valve and the orifice. As in Case I, this system also compensates in part for variations in specific gravity on a Btu. input basis to the furnace.

Summary

From a control point of view, Case I is the best, as the slope is fairly constant at the higher thruputs of Q, and at relatively small thruputs the slope decreases. This characteristic approaches that of an equal percentage curve which is generally accepted as ideal for temperature control. This means that the "TC" controller's proportional band adjustment can be set as narrow as possible without producing a cycling when the process demand decreases or increases.

In Cases 2 and 3, at low values of P or h the slope varies rapidly, and if the "TC" controller proportional band adjustment is set at its optimum value for one condition of process load it would be incorrect for all other process loads. At higher loads the control would become sluggish; at lower process loads the control would become cyclic. However, at high values of P in Case 2 the slope is essentially constant and optimum proportional band adjustment may be maintained for reasonable variations in process load.

If the process demand variation is less than 25%, Case 2 is the best from a practical point of view, assuming, of course, the burner header pressure is higher than 5 or 6 psig. This system has the least first cost and the least maintenance. The pressure balance valve is nearly friction free and can handle dirty, corrosive, wet fuel gas satisfactorily. Furthermore, there is no requirement for 40 or 50 pipe diameters straight run or straightening vanes before the orifice.

The constructive criticisms and suggestions of Messrs. David Hostedler and Richard Parcels, Petroleum Refinery Division, Foster Wheeler Corp., are gratefully acknowledged.

Lube Oil Outlook

Reprints have been prepared of the article "The Outlook for Lube Oils," by R. E. Smoley, published in the August issue of PETROLEUM PROCESSING. A post card request to the editor will bring you a copy, with our compliments. Address:

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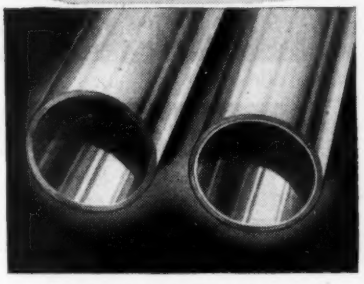

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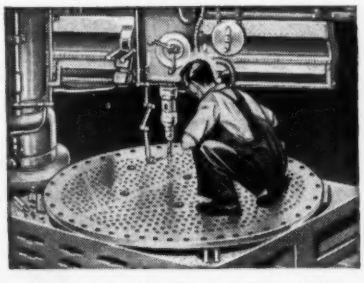

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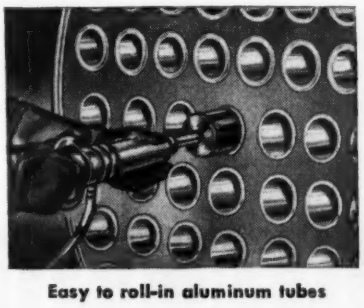

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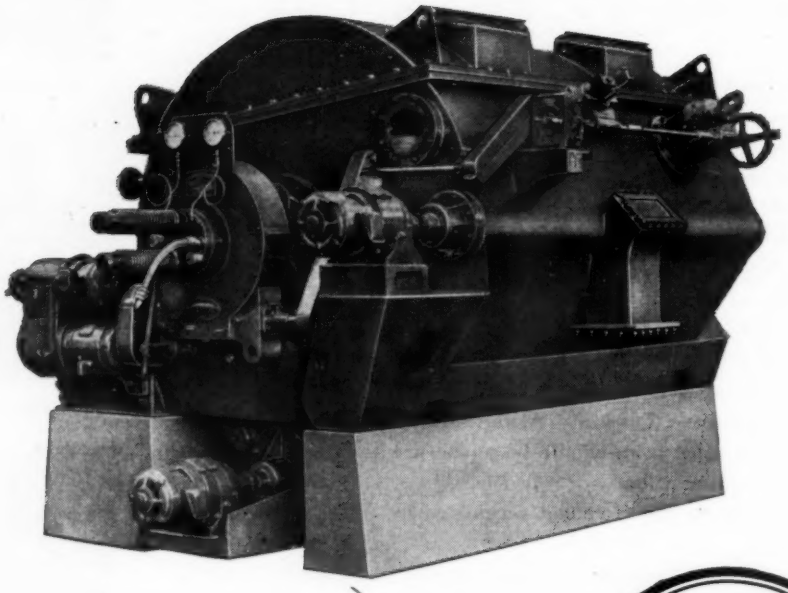

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Patent Trends in Petroleum Refining

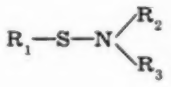
By PETER J. GAYLOR

Patent Attorney and Editor "The Technical Survey"

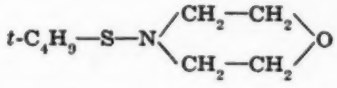
Inhibiting Oxidation of Lubricating Oils

THE OXIDATION of lubricating oils may be inhibited by various organic compounds, and several thousand of them have been described in the literature. Most of them possess an antioxidant group, such as the phenol, thiophenol, or amino, plus a solubilizing group to make the compound sufficiently soluble in the oil.

A novel group possessing such antioxidant properties is disclosed in the Phillips Petroleum Co.'s U. S. patent 2,439,734. This group is represented by the formula



and the class of compounds most appropriate is that of the alkyl sulfenamides, such as the sulfenamide made by reacting tert-butyl mercaptan and morpholine and having the formula



designated as N-t butylsulfenylmorpholine.

The utility of this compound may be appreciated from data given in Table 1. It will be noted that the neutralization number, carbon residue and viscosity increase on heating have been markedly reduced by the use of 0.25% of the compound.

From Fig. 1, it will be observed that, although the different compounds have about the same effectiveness in 1% concentration, the sulfenyl piperidines appear to be more potent than the morpholines, both of which are much more effective than the sulfenamides in lesser concentrations, such as 0.1-0.2%, which is the usual additive concentration.

TABLE 1—Effect of heating on Mid-Continent neutral oil containing 0.25 wt.-% N-t-butylsulfenylmorpholine

	WITHOUT INHIBITOR		WITH INHIBITOR	
	New Oil	Heated at 350° F.	New Oil	Heated at 350° F.
Evaporation Loss	.....	4.2	.....	3.7
Naphtha Insoluble, %	.....	0.09	.....	0.03
Neutralization Number	0.07	0.47	0.06	0.18
Carbon Residue, Ramsbottom	0.03	0.19	0.06	0.06
Viscosity at 100° F., SUS	292.4	329.9	287.3	311.4
Viscosity (corrected for Evap. Loss)	313.6	.....	308.9	.....
Viscosity Increase, %	.....	5.20	.....	0.81

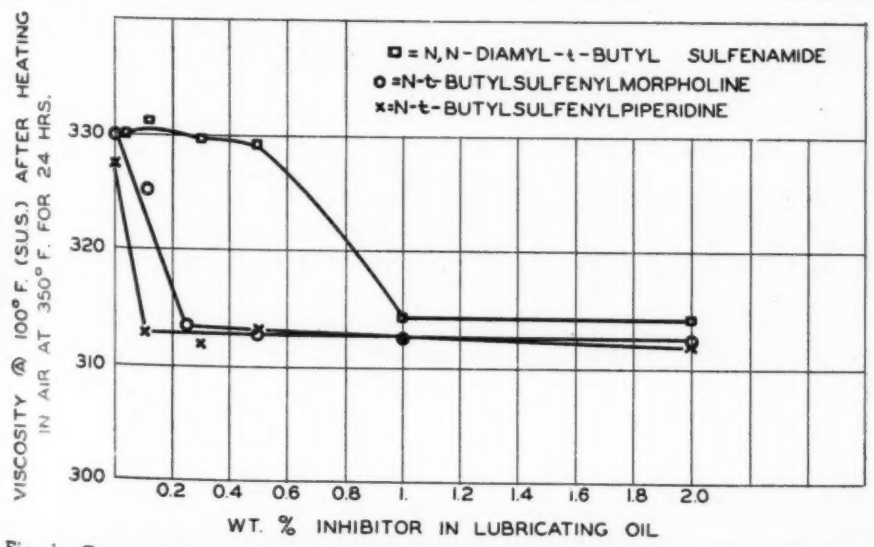


Fig 1—Comparison of effectiveness of various alkyl sulfenamides in inhibiting the oxidation of lubricating oils. (Phillips Petroleum Co., U. S. 2,439,834)

Clay Catalysts

IN ITS U. S. 2,423,309, Filtrol Corp. describes a method for producing dry catalytic pellets of acid-treated clay. The steps involve making moist pellets from wetted granules, mixing them with relatively dry granules of the same clay so as to dry the pellets, separating the granules from the pellets, and adding more water to the granules to convert them into pellets.

Correction

In the section of Patent Trends in the July issue of PETROLEUM PROCESSING entitled "High Efficiency Lubricants", Standard Oil Co. (Indiana) was given as the owner of the lubricating oil additive patent, U.S. 2,439,819. This was in error. Standard Oil Co. (Ohio) is the owner of U.S. Patent No. 2,439,819.

Purifying Wax

MICROCRYSTALLINE petroleum waxes generally possess a variety of odors, flavors and colors, depending on source, method of manufacture and degree of purification. Clay filtration is usually resorted to for removing most of these undesirable properties, but it is said that such treatment imparts an "earthy" or "moldy" flavor to the wax, the intensity of which increases with the extent of removal of the impurities originally present.

The Continental Can Co. U. S. patent 2,441,202 describes a process for providing an odor and flavor-free wax having substantially no acid number and saponification value and an NPA color greater than 1 and which, even when aerated at 50° F. above its ASTM melting point, for periods upwards of 240 hrs., remains odor and flavor free.

Good results are obtained when the clay percolated wax, mixed with plasticizer (e.g. white petrolatum) is percolated with boneblack and then steamed to remove volatile impurities, at a temperature just below that causing foam.

Fig. 2 illustrates a flow-sheet of one preferred process. It will be observed that the wax is melted in

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tank 10, clay percolated in jacketed tank 11, then passed into color blending and receiving agitated tanks 14a and 14b, from which the wax is passed into holding tanks 18 where it is blended with the plasticizer from tank 20.

The plasticized wax is run into jacketed measuring tanks 30 and pumped from them, by means of jacketed pump 33, into boneblack percolator 35, after which it is steamed in tanks 40, cooled, and run into slabbing mold 48.

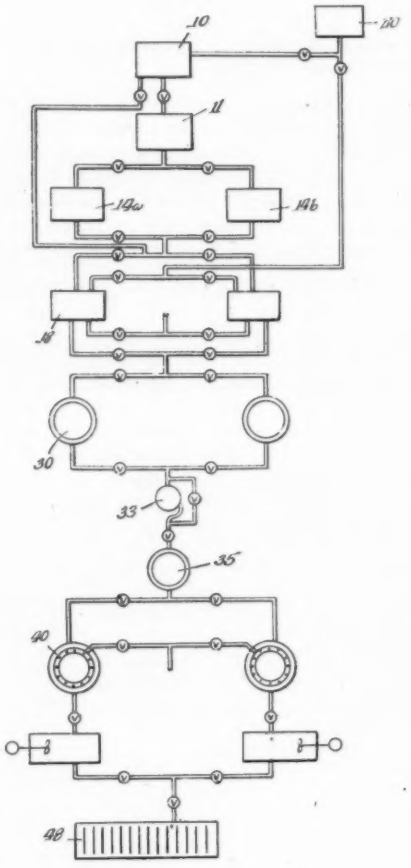

Fig. 2—Flow diagram of Continental Can Co.'s new process for purifying microcrystalline waxes. (U. S. 2,441,202)

Selected Patents

U. S. PATENTS issued from June 15, 1948, to July 13, 1948

U.S. 2,443,180 (Socony-Vacuum)—Transfer of particle form solids.
U.S. 2,443,190 (Stand. Oil Dev.)—Contacting solid particles with gaseous fluids.
U.S. 2,443,210 (Phillips Petroleum)—Quenching of hot gases.
U.S. 2,443,229 (SOD)—Extracting methyl chloride from hydrocarbons.
U.S. 2,443,247 (SOD)—Mesitylene.
U.S. 2,443,264 (SOD)—Compounded lube oil.
U.S. 2,443,285 (Universal Oil Prods.)—Catalytic reforming.
U.S. 2,443,237 (SOD)—Aluminum bromochloride polymerization catalyst.
U.S. 2,443,291 (Sinclair Refg.)—Trichloroacetamide.
U.S. 2,443,292 (Sinclair Refg.)—Ammonolysis of monochloralkyl nitriles.
U.S. 2,443,337 (Phillips Petr.)—Catalytic conversion.
U.S. 2,443,418 (Anglo-Iranian Oil)—Isomerization.
U.S. 2,443,423 (Phillips Petr.)—Endothermic catalytic conversions.
U.S. 2,443,462 (SOD)—Drying spherical hydrogel catalysts.
U.S. 2,443,503 (duPont)—Hydrogen peroxide by partial oxidation of hydroaromatic hydrocarbons.
U.S. 2,443,578-9 (Socony)—Rust preventive.
U.S. 2,443,585 (Socony)—Steam cylinder lubricant.
U.S. 2,443,607 (S. O. Ind.)—Heptane isomerization.
U.S. 2,443,673 (Texas Co.)—Method of effecting catalytic conversions.
U.S. 2,443,773 (Phillips Petr.)—Catalytic apparatus.
U.S. 2,443,811 (Shell Dev. Co.)—Production of thiophenols.
U.S. 2,443,817 (SOD)—Catalytic polymerization of hydrocarbons.
U.S. 2,443,832 (SOD)—Oxidation of aromatic compounds.
U.S. 2,443,833 (Emery Indus., Inc.)—Cutting oil base.
U.S. 2,443,840 (Ernest Stossel)—Processes of producing high melting point waxes.
U.S. 2,443,841 (SOD)—Process for power generation.
U.S. 2,443,852 (Sharples Chemicals, Inc.)—Condensation of olefinic compounds with hydrogen sulfide.
U.S. 2,443,854 (SOD)—Fluidized-solid process for forming carbon disulfide.
U.S. 2,444,035 (Koppers Co., Inc.)—Process for dehydrogenating hydrocarbons using as catalyst calcium oxide on calcium carbonate.
U.S. 2,444,057 (SOD)—Polymerization process.
U.S. 2,444,123 (UOP)—Method of reactivating finely divided contact material.
U.S. 2,444,131 (UOP)—Conversion of hydrocarbon oils.
U.S. 2,444,256 (Shell)—Method for manufacturing hydrogen chloride.
U.S. 2,444,258 (Socony)—Method and apparatus for conversion of fluid hydrocarbons.
U.S. 2,444,269 (L. Sonneborn Sons, Inc.)—Light stability of petroleum waxes.
U.S. 2,444,289 (Socony)—Preparation of phosgene.
U.S. 2,444,357 (Lockheed)—Lubricant for drills and cutting tools.
U.S. 2,444,478 (Sinclair Refg.)—Tetrachlorobutyronitrile.
U.S. 2,444,509 (UOP)—Al-Zn-Cu catalyst.
U.S. 2,444,610 (Hene)—Treating petroleum cracking residues.
U.S. 2,444,650 (Socony)—Cracking hydrocarbons.
U.S. 2,444,720 (Shell Dev.)—Lithium base greases.
U.S. 2,444,832 (SOD)—Removing vaporous reactants from catalysts.
U.S. 2,444,848 (SOD)—Continuous polymerization of isobutylene.
U.S. 2,444,855 (SOD)—Aromatics by thermal cracking.
U.S. 2,444,913 (Houdry Process)—Zirconia catalysts.
U.S. 2,444,947-8 (S. O. Ohio)—E. P. lubricant.
U.S. 2,444,965 (UOP)—Clay catalyst.
U.S. 2,444,970 (SOD) — Grease containing sulfonate.
U.S. 2,444,990 (SOD)—Contacting solid particles and gaseous fluids.
U.S. 2,445,092 (Socony)—Heat transfer with granular solids.
U.S. 2,445,064 (Tootal-Broadhurst Lee)—Reagent comprising alkali-alcohol and petroleum distillate.
U.S. 2,445,139 (Shell Dev.)—Polymerizing unsaturated esters in presence of peroxide and hydrogen halide.

FOREIGN PATENTS (and Applications)

Brit. Appl. 1635/48 (Shell)—Grease.
Brit. Appl. 2018/48 (Shell)—Amino alcohols.
Brit. Appl. 2020/48 (Shell)—Solvent extraction.
Brit. Appl. 2148/48 (Shell)—Heterocyclic alcohols.
Brit. Appl. 2149/48 (Shell)—Sodium alkyl sulfates.
Brit. Appl. 1961/48 (Packard Motor Car)—Pulse-jet combination.
Brit. Appl. 1705/48 (Texas)—Gasoline synthesis.
Brit. Appl. 6998/48 (Anglo-Iranian Oil)—Detection of water.
Brit. Appl. 6494/48 (Anglo-Iranian Oil)—Carbon monoxide products.
Brit. Appl. 6563/48 (Anglo-Iranian)—Petroleum hydrocarbons.
Brit. Appl. 6719/48 (Shell)—Lubricants.
Brit. Appl. 6930/48 (Shell)—Esterification.
Brit. Appl. 6605/48 (SOD)—Lubricants.
Brit. Appl. 6606-7/48 (SOD) — Carbonaceous materials.
Brit. Appl. 3161/48 (Koppers)—Dehydrogenation catalyst.
Brit. Appl. 23014/47 (Shell)—Synthetic lubricant.

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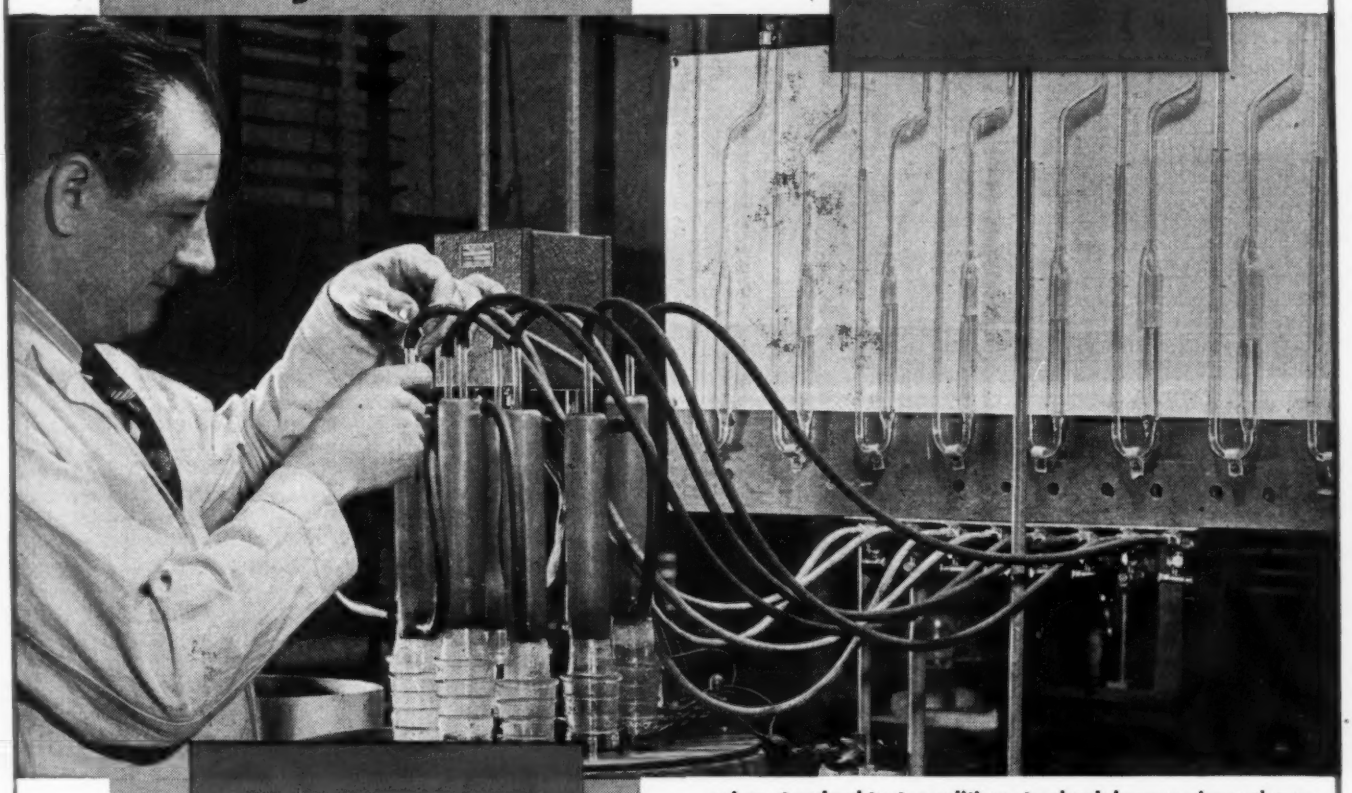

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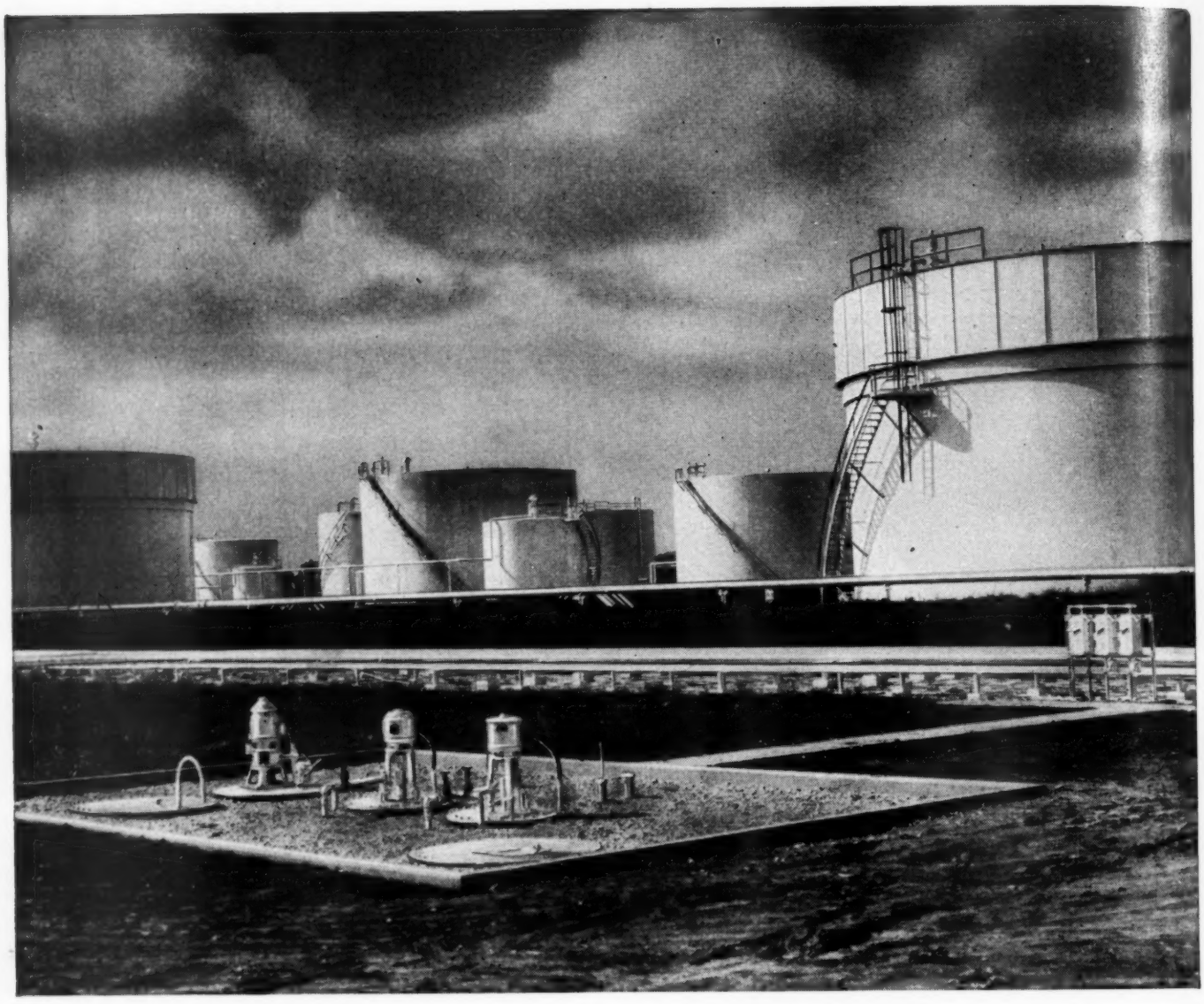

WHERE OUTPUT EQUALS INPUT

Sounds fundamental . . . but where conservation is not practiced properly, there is a costly difference between what is pumped into a terminal and what is pumped out. Vapor losses make this difference. The two Expansion Roof tanks (left and right) are proof that conservation is complete in this terminal . . . that breathing losses have been eliminated and when vapor volumes are balanced during filling and emptying operations (as they normally are) there are no filling losses.

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Use Variations in Consistency To Control Wax Filtering Rate

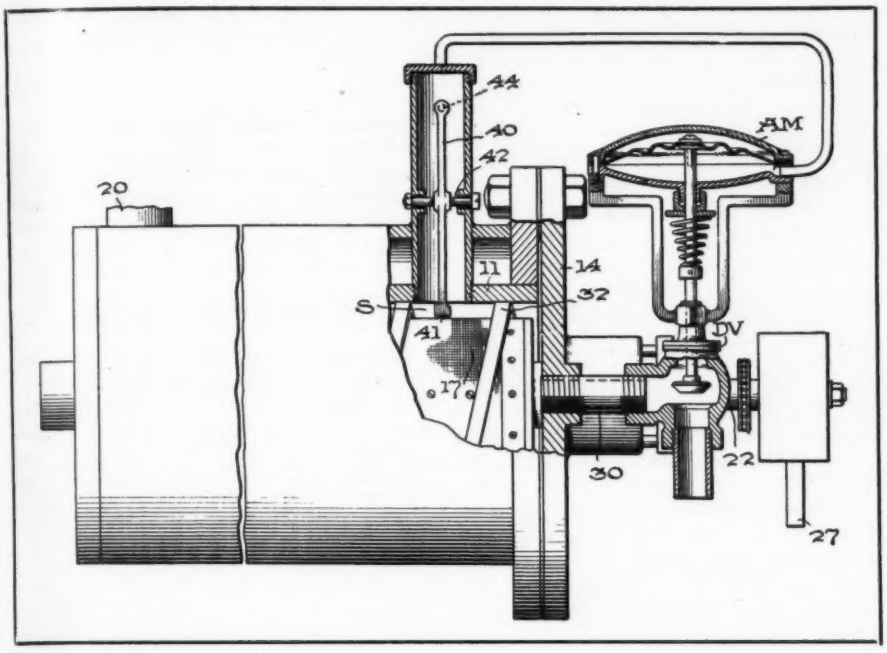


Fig. 1—Paddle 41 picks up differences in wax consistency to control discharge valve *DV* through pilot air system in new wax filter (U. S. 2,444,563)

OPERATION OF A ROTARY wax filter at optimum filtering rate and for most efficient de-oiling is accomplished by controlling the valve on the wax discharge line by variations in consistency of the wax being accumulated on the surface of the filtering screen.

The apparatus, with enlarged detail of the control mechanism, is shown in Fig. 1. Slurry enters via line 20, passing into annular space *S* between the rotating filter element 17 and the inside wall of inner shell 11. Oil filtrate passes through screen 17 and hollow drive shaft 22 to discharge line 27. Wax builds up on outer surface of screen 17 and is carried to the discharge end of the shell at the right by stationary helical blade 32. It then passes out through discharge line 30, located in end plate 14 at a point off center, and thence out through air motor-operated discharge valve *DV*.

Variations in the consistency of the wax accumulation on screen 17 impart variations in force against paddle 41 at the end of lever 40, which is mounted at its midpoint on axis 42 as a fulcrum. These variations in turn are transmitted to pilot air valve at 44 (not shown), which controls air motor *AM* and discharge valve *DV*. The mechanism is adjusted so that *DV* tends to close when the wax is soft and, conversely, open when wax is stiff.

U. S. 2,444,563, issued July 6, 1948, to Adam H. Gebauer, assignor to Tide Water Associated Oil Co., Bayonne, N. J.

Improve Arc-type "Metallizer" By Air-driven Feed, Vibrator

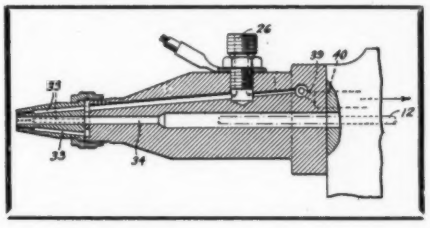


Fig. 2—Air passing through ducts 33 in arc-welding nozzle has forging action in metallizing method (U. S. 2,445,177)

WELL BONDED, homogeneous, and nonporous layers of metal can be laid down on a surface to be repaired with an arc-welding apparatus for "metallizing" claimed to be an improvement over ordinary spray gun or arc-welding techniques. It is also not necessary for the operator to be concerned about the size of the arc.

The method utilizes low voltage-high amperage current (typical values—3 volts and 600 amps.) and a special nozzle arrangement shown in Fig. 2 for feeding the wire or rod stock metal to be deposited. Stock 12 passes through the center channel 34, being fed by an air turbine drive. Air also passes through four ducts 33 in the nozzle, creating a stream of air impinging on the work and providing a forging action which reduces sponginess in the deposits and which cools the work piece, reducing temperature stresses.

Air at about 30 to 40 psi. is fed to the mechanism via inlet line 26; a portion of it passing to ducts 33, and balance passing through needle valve 39 and channel 40 to the air turbine. Rate of feed for stock 12 is therefore closely controlled by needle valve 39.

Further efficiency in depositing the metal layer is obtained by an air driven vibrator on the entire assembly (not shown) which provides for exceedingly rapid vibration through a very small magnitude at the arc end of the tool.

U. S. 2,445,177, issued July 13, 1948, to Harald L. Lindblad, assignor to Metallizing Co. of America.

Find Economy in Initial Cost For Modified Heater Design

LOW FIRST COST, claimed as one economic feature in a design for a tubular heating furnace for hydrocarbon oils, is achieved through lower height than with conventional designs, and with little wall surface exposed to direct radiant heat.

Radiant tubes cover vertical sidewalls, sloping sidewalls, and roof. Convection tubes are constructed with extended fins to increase heat transfer efficiency and consequently reduce the number of tubes required as well as the number of return bends, headers, and joints. In addition, the convection tubes have been located closer to the floor than in conventional practice, resulting in decreased tube sheet area. This was made possible by locating the outlet flue gas passage directly adjacent to the first rows in the bank of convection tubes.

U. S. 2,445,316, issued July 20, 1948, to Bartholomeo De Lorenzo, assignor to Foster Wheeler Corp., New York, N. Y.

Combine Two Safety Features In Corrosion-Resistant Valve

VALVES FOR HANDLING corrosives at high or low pressure and temperature are conventionally protected either by a heavy metal bellows of sufficient strength to withstand the internal pressures of the system, or by pumping oil from an external source into the valve stem packing at a pressure slightly higher than the line fluid pressure.

The disadvantage cited for the bel-

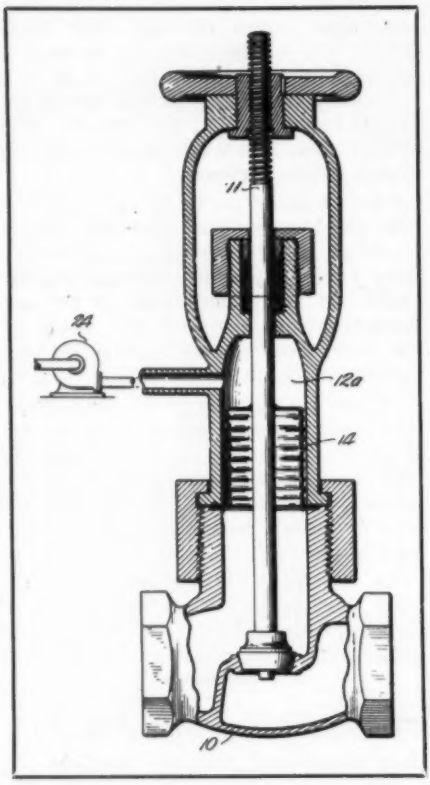


Fig. 2—Corrosive materials are handled safely in valve using bellows 14 along with external oil under pressure (U. S. 2,444,703)

lows method is that its inflexible construction restricts valve stem movement and makes for difficult operation; and for the second method, the likelihood of contamination through infiltration of the external oil directly into the line fluid. These drawbacks, it is said, are overcome in a design combining the essential features of both systems.

As shown in Fig. 2, the method is illustrated in a globe valve, but it is equally adaptable to gate, needle, or other conventional types. Bellows 14 is corrosion-resistant material but of lightweight construction. This is possible because centrifugal pump 24 maintains the external oil pressure in chamber 12a at only a slight differential over that of the line fluid in valve body 10. The fact that the bellows 14 is thin metal provides easy up and down motion in stem 11 and correspondingly easy valve operation.

U. S. 2,444,703, issued July 6, 1948, to Harry R. Jones, assignor to Continental Oil Co., Ponca City, Okla.

How to Obtain Patents

Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number from: The Commissioner of Patents, Washington 25, D. C.

Bubble Cap Fastening Improved By Serrated Key Arrangement

A SERRATED KEY arrangement for securing bubble cap and flue assemblies in fractionating trays enables workmen for the most part to handle maintenance and repair work from outside the tower. This is not possible, it is said, with caps of conventional design, utilizing bolt and nut fastening means, especially because of the tendency of such a structure to tighten progressively during operation of the tower.

The invention is said to be as easy to disassemble as it is to assemble. It is shown in exploded perspective in Fig. 3. Flue 14 incorporates a special stem 18 welded across its diameter. Stem 18 passes through slot 36 in the center of the grooved cap 26. Key 28 is then passed through slot 20 in the stem 18, locking itself in place through teeth 37. Any hooked tool with a long handle can be inserted through the tower manhole or handhole to jerk key 28 loose when a cap is to be removed.

U. S. 2,445,083, issued July 13, 1948, to Merrill R. Reed, Kansas City, Kans.

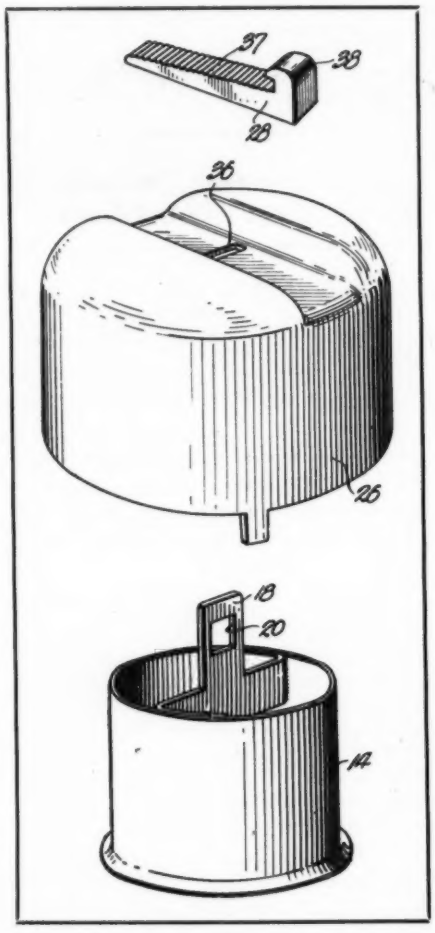


Fig. 3—Key 28 secures cap 26 tightly in place, but can be quickly jerked loose by hook 38 (U. S. 2,445,083)

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with greatest interest:

Conveyor Chain for moving-bed catalytic conversion units employing design to reduce wear and breakage of linkage through improved knuckle pin and side bar. U. S. 2,444,812, issued July 6, 1948, to J. A. Crowley, Jr., and W. D. MacGregor, assignors to Socony-Vacuum Oil Co., Inc.

Constant Temperature Bath for laboratory use in range from −70° C. to room temperatures, utilizing hopper of solid carbon dioxide, whose depth of immersion is closely controlled. U. S. 2,444,416, issued July 6, 1948, to E. E. Bergman, Red Bank, N. J.

Non-sticking Gate Valve in which freezing of gate because of temperature differential between it and valve body is reduced through use of a small side channel which directs flowing fluid against gate in its open position. U. S. 2,444,401, issued June 29, 1948, to W. J. Gartz, Crane Co., Chicago, Ill.

Catalytic Conversion Apparatus for either high exothermic or endothermic reactions in which heat requirements are handled without expense of many small tubular or narrow annular catalyst chambers in heat-exchange relationship with the temperature controlling medium. Achieved by controlled flow of the reactant materials themselves through the vessels. U. S. 2,443,773, issued June 22, 1948, to M. P. Matuszak, assignor to Phillips Petroleum Co., Bartlesville, Okla.

Thermocouple provides greater sensitivity by enclosing entire assembly except hot junction in protective jacket; also enabling its use in vessels under high pressures. U. S. 2,445,159, issued July 13, 1948, to C. S. Tegge, assignor to The Brown Instrument Co., Philadelphia, Penna.

Fluid Catalytic Unit in which both reaction and regeneration vessels are substantially at ground level so that standpipes, screw feeds, and lock hoppers for building up pressure are eliminated, and use is made of star feeders for sealing one reaction vessel from another. U. S. 2,440,482, issued April 27, 1948, to Homer Z. Martin, assignor to Standard Oil Development Co.

FOR MORE INFORMATION—use one of these reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage needed

EQUIPMENT
MATERIALS
PROCESSES
LITERATURE

What's New!

Reviewed by WILLIAM C. UHL, Equipment Editor

New Instruments

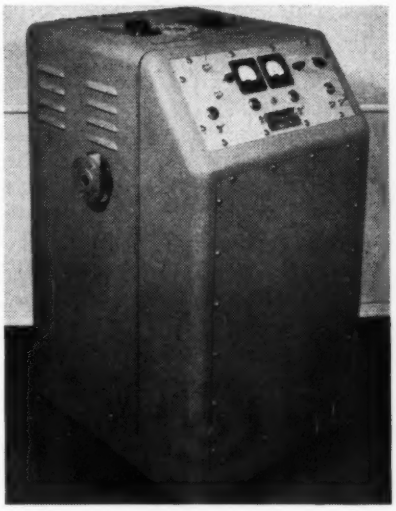
THE latest developments in instrumentation and automatic control devices for the petroleum processing industry will be among the exhibits by 160 manufacturers at the Instrument Society of America's Third National Instrument Congress and Exposition in Philadelphia at Convention Hall next week, Sept. 13-17.

The following selection of "What's New!" items—Nos. 1 to 9 inclusive—is representative of the new products to be shown. Many others scheduled for display have already been reviewed on these pages during the past few months.

1—Automatic Blender

An automatic, two-component, continuous volumetric blending apparatus is particularly adaptable for lubricating oils, gasolines, addition of tetraethyl lead compound, and the like. Servomechanisms are used in the controlled flow of two liquids by volume ratios. Complete electrical interlocks are provided to protect the servo systems against failures. Automatic signals indicate continuance of supplies of materials, and the units shut down if supply of either component fails. High accuracies—about 0.25%—are obtainable, it is claimed. Proportioneers, Inc. **Booth 541 at the ISA Show.**

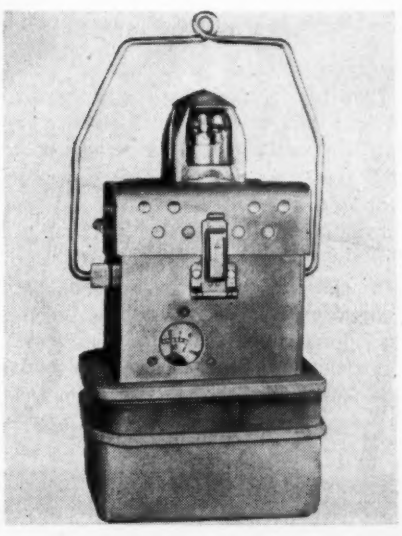
2—Leak Detector



The Model 24-101 Leak Detector is essentially a simplified portable mass spectrometer, designed for the single purpose of detecting minute traces of helium. By connecting the instrument to an evacuated system and applying helium to the suspected areas, it is possible to locate leaks too small to be found by other means. It is also adaptable to checking pressure systems by inclusion of helium in the atmosphere surrounding the suspected area or the entire unit. The method does not necessarily involve shutdown, since an addition to a flowing stream in a refinery vessel of a very small quantity of helium is all that is needed and would not affect operations. Unit measures 22 x 25 x 45 in., weighs 300 lbs., mounted on rubber-tired ball-bearing casters. It has both visible and audible alarms for one-man operation; operates on 115 volts, 60 cycle AC current. Consolidated Engineering Corp., **Booth 226 at the ISA Show.**

3—Portable Methane Alarm

The new MSA Portable Methane Alarm is preset to operate at a given concentration of combustible gas and stands guard during a working shift; for example, for repair jobs in the vicinity of recycling plants or in tank cleaning operations. Conventional prior procedure entailed periodic checking on the natural gas content in the air. With the MSA device, when the atmosphere reaches the preset concentration, the alarm signals with a flashing light, which continues to flash until the concentration has been reduced and the instrument reset by tilting. The unit weighs less than 11 lbs., and operates on a small self-contained, Edison, iron-alkaline battery. It has been approved by the U. S. Bureau of Mines. Mine Safety Appliances Co., **Booths 119, 121 at the ISA Show.**



More "What's New!" Items, p. 891

DON'T SAY "ANTIMONIAL ADMIRALTY"—

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ANTIMONIAL ADMIRALTY"

It could well mean a great saving to you.

You see, the minimum percentage of antimony set forth in Chase Patent No. 2,061,921 is .007%. Under certain mild exposure conditions this quantity would prove effective. However, experience has shown that a minimum of about .015% is essential to give reasonably complete protection against dezincification under the entire range of conditions.

To assure you this .015% minimum, Chase manufacturing processes incorporate nominally .035% antimony in their admiralty. Why risk tube failures when you can specify *Chase* Antimonial Admiralty, *which costs you no more than plain Admiralty*. Write or call your nearest Chase Warehouse or Sales Office today, listed below.

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses at BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO also carried by— Vinson Supply Co., TULSA Standard Brass & Mfg. Co. HOUSTON

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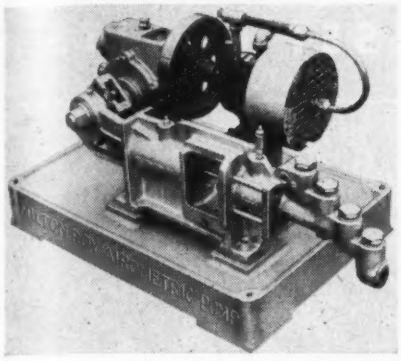
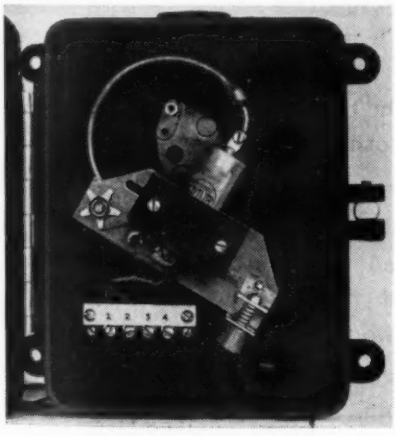
4—Air-driven Pump



For use in hazardous locations or where electric power is not available, the "Air-o-metric" controlled volume chemical pump is now available. The air-drive has been adapted to standard previous models of electric motor driven pumps. It can be operated by natural gas or compressed air at pressures from 50 to 80 psi. Maximum motor speed is 1750 rpm., held constant by a governor which throttles the air exhaust from the motor. Capacities are from 1.2 to 75.5 gph. and from 2.4 to 151 gph. in two models. Maximum discharge pressures range from 115 to 9500 psi. Milton Roy Co. **Booth 112 at the ISA Show.**

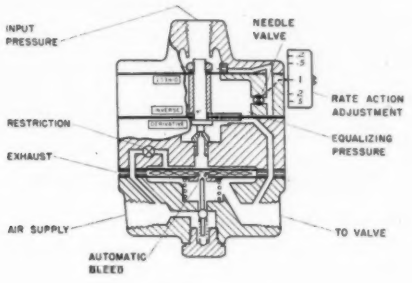
5—Temperature Control



The "Atcotran" Automatic Temperature Control is a pressure measuring system based on applying a differential transformer, which develops a linear output, to standard primary measuring elements such as Bourdon tubes or Bellows, depending upon pressure range. It is said to eliminate the inherent problems of Bourdon tubes by using no instrumentation gear. The armature is direct-connected to the tube tips—no jewel bearings, pivots, springs, or similar movements are used. Transmitters and receivers are accurate to within 0.25% reading, with a sensitivity of 1 in 4000. Dust-tight enclosures make units suitable for service in such corrosive applications as hydrogen sulfide-bearing gas and oil, oxygen, ammonia, fluorides, hydrochloric acid, brine, and caustic soda. Standard ranges are 0 to 30, 100, 500, 1,000, 5,000 and 10,000 psi. Automatic Temperature Control Co., Inc. **Booths 146, 148 at ISA Show.**

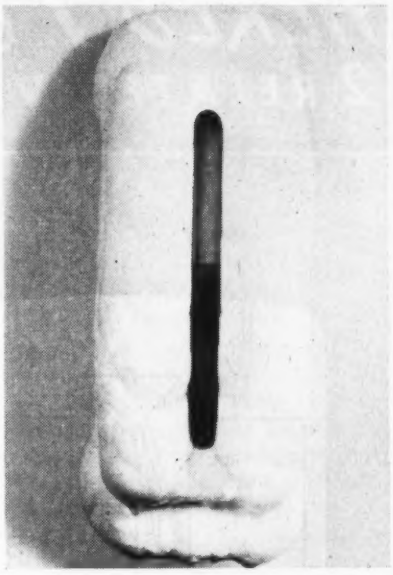
6—Inverse Derivative

The "Inverse Derivative Unit" was designed for use with the Moore "Nullmatic" Controller in order to superimpose on this instrument's output a new type of control action. Like the controller, the Inverse unit operates on the pneumatic force-balance system. It is applicable to all processes in which the reaction time through the process is faster than the correction time through the control valve. All liquid flow, gas flow, pressure, and liquid level control applications with small capacities come in this category generally. The action of the new device temporarily widens the proportional band, in contrast to the action of direct derivative controllers, which temporarily narrow the proportional band. In operation: the instant the process tends to become unstable or to go into a cycle, the Inverse Derivative Unit acts to temporarily widen the proportional band, which action restores stability to the process. Tests have demonstrated that the unit permits a reduction of the band setting to less than 1/5th of normal. Moore Products Co., **Booths 106, 108, 110 at the ISA Show.**



7—Non-frosting Gage

The Flat Glass Non-Frosting Gage is said to be ideal for refineries, recycling plants, and generally for services where low temperature fluids are to be gaged. It is built with a transparent plastic extension unit, sealed to the conventional gage glass and projecting beyond the cover bolts



so that frost cannot build up across the vision slot. It can be made in any material to meet any operating conditions, and is available in both reflex and transparent types. Jerguson Gage & Valve Co. **Booth 444 at the ISA Show.**

8—One-piece Control

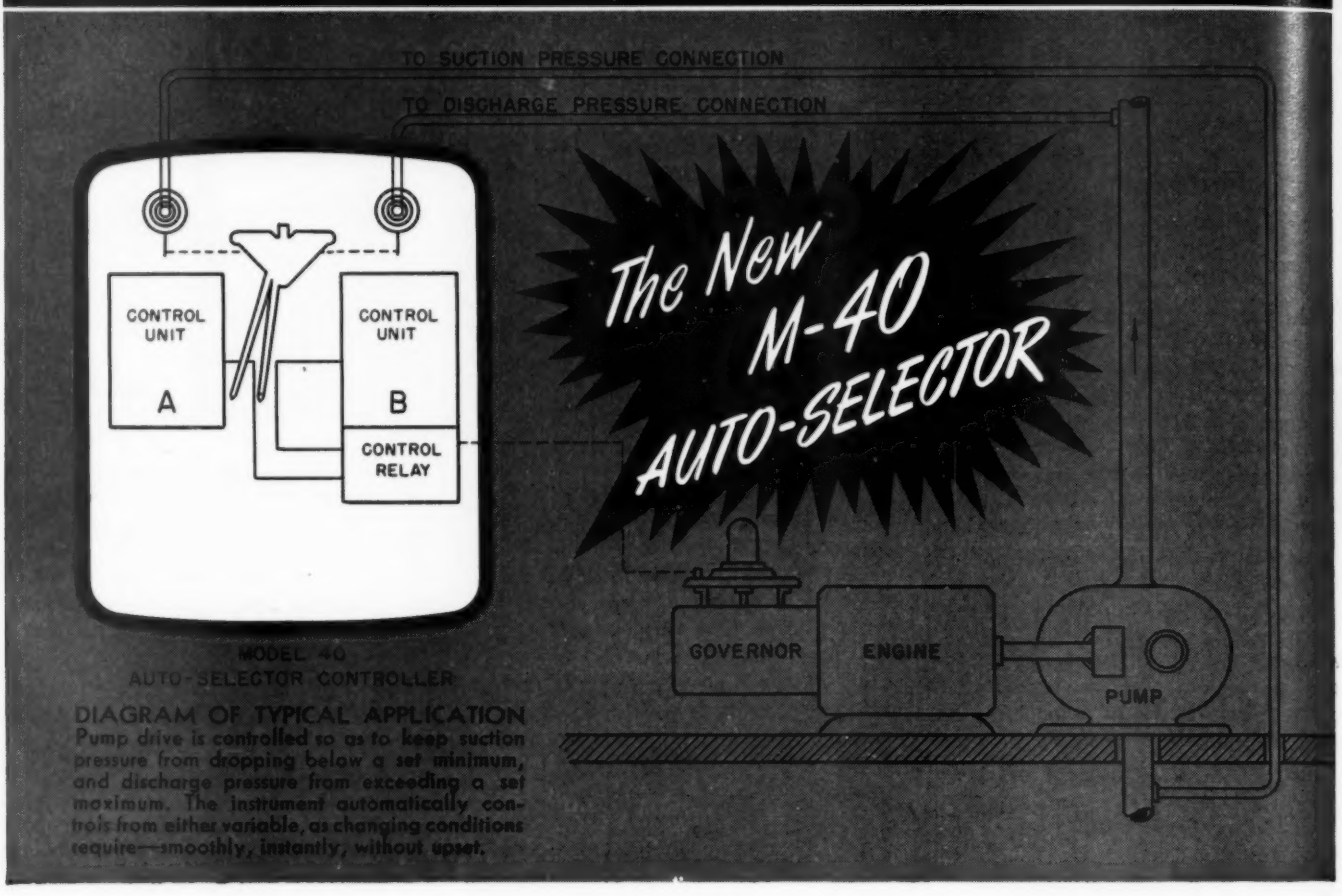
With the new one piece Pneumatic Control Mechanism now being incorporated in Fischer & Porter flow control instruments, the entire assembly may be removed from the instrument for cleaning or repair without disturbing the process. The transfer valve is turned to the "Service" position, a single air line is disconnected and four screws removed. The housing consists of a one piece die casting, resulting in all component parts being maintained in a positively fixed relationship to each other. Fischer & Porter Co. **Booths 500, 502, and 504 at the ISA Show.**

9—Electronic Rotameter

The "Inductronic" remote flow recording and controlling rotameter features electronic power and a servo motor drive for the recording pen and pneumatic control system. The basic electrical circuit is the induction bridge. The float has an extension with a soft iron core which move inside two induction coils. The remote instrument has a similar armature and set of coils which are joined electrically to those in the rotameter to form the bridge circuit. Brooks Rotameter Co. **Booth 144 at ISA Show.**

More "What's New!" Items, p. 893

HERE'S 1 CONTROLLER THAT HOLDS 2 RELATED VARIABLES WITHIN SET LIMITS



MODEL 40
AUTO-SELECTOR CONTROLLER

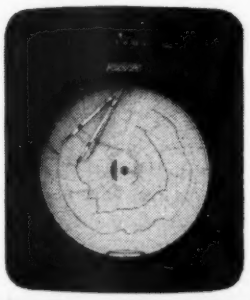
DIAGRAM OF TYPICAL APPLICATION
Pump drive is controlled so as to keep suction pressure from dropping below a set minimum, and discharge pressure from exceeding a set maximum. The instrument automatically controls from either variable, as changing conditions require—smoothly, instantly, without upset.

THE NEW FOXBORO AUTO-SELECTOR CONTROLLER operates from two related measurements, automatically transferring control from one to another as required, to prevent either one from exceeding its set limit. As in the case diagrammed above, when supply is greater than demand, control is maintained on the demand side (discharge) . . . but when demand exceeds supply, control is maintained on the supply side (suction).

Having two measuring elements and control mechanisms, and a combined air relay, this instrument actually does the work of two . . . and provides records of both measurements on one chart. It will be seen that either one or the other variable is under control at all times. Due to the unique design and inter-relationship of controller elements, the transfer of control from one variable to the other is smooth, instant, and with no upset.

Any type of control action may be used. Any combination of related variables may be controlled—pressure and flow, temperature and level—or two flows, two pressures, etc.

If you have a process that might benefit from this automatic selection type of control, write for details. **The Foxboro Company, 246 Neponset Ave., Foxboro, Massachusetts, U. S. A.**

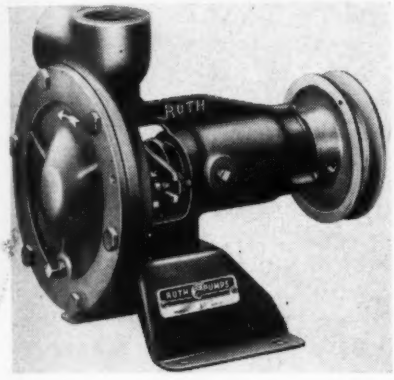


FOXBORO
REG. U. S. PAT. OFF.
RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

Other New Products

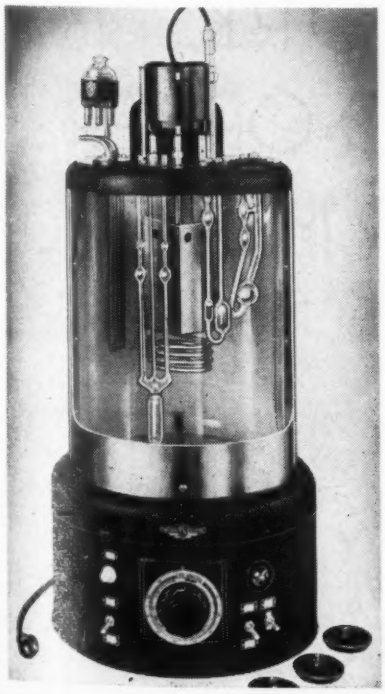
10—Turbine Type Pump

The Model 0023, turbine type pump for liquid transfer furnishes pressures up to 80 psi., speeds up to 2200 rpm., and capacities up to 8 gpm. It is all-bronze construction with a stainless steel shaft and double ball bearings. It is available with or without motor, base, and coupling. The pump will handle condensate without vapor binding, it is said. Roy E. Roth Co.

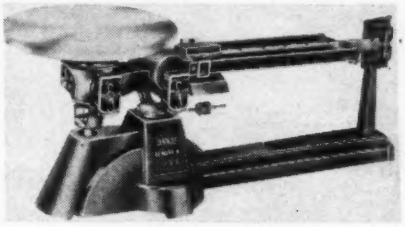


11—Viscosity Bath

The Precision "Model S" Kinematic Viscosity Bath has been designed for Ostwald, Ubbelohde, or other suspended level viscometers. Temperature range of from approximately 70 to 212° F., with a sensitivity of plus or minus 0.05° F. It is constructed of a 12 in. diameter by 18 in. high Pyrex jar with 3/16 in. walls. To provide insulation, a stainless steel jacket with a large Plexiglass window fits over the jar with an air space of about ¾ in. Two immersion heaters, 300 and 500 watts, provide heat. Overall dimensions are 35 in. high by 20 in. diameter. Capacity of Pyrex jar is 7 gals. Precision Scientific Co.

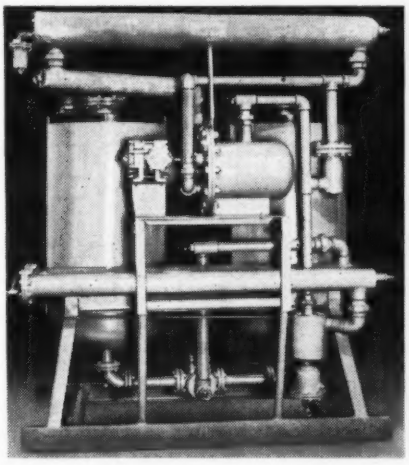


12—Stainless Beam



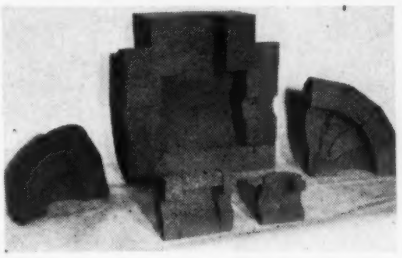
The Ohaus Triple Beam Balance includes stainless steel platform and beams for increased service life by providing corrosion resistance at points of continuous usage. The model shown, No. 750-S, with metric calibration has an overall capacity of 2610 grams, with a rated sensitivity of 0.10 gm., and an actual sensitivity of 0.05 gm. It is also available in avoirdupois standard with decimal and fractional ounce calibrations. Ohaus Scale Corp.

13—Drys Instrument Air



Employing activated alumina as a solid adsorbent, the new "BY" line of Lectrodryers has been designed primarily for drying instrument air. They are fully automatic and said to be more compact than previous models. They are built as standard for operation on pressures up to 150 psig., with the option of either steam or electric reactivation of the adsorbent. A range of standard sizes is furnished up to 5000 scfm. Pittsburgh Lectrodryer Corp.

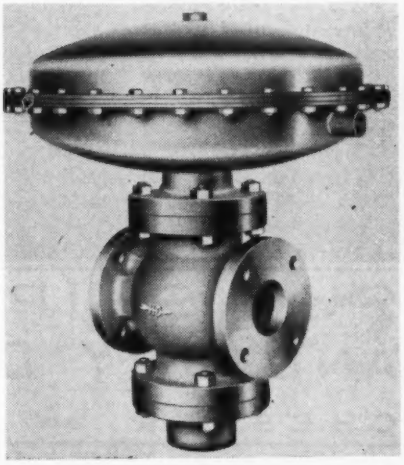
14—Pipe-fitting Insulation



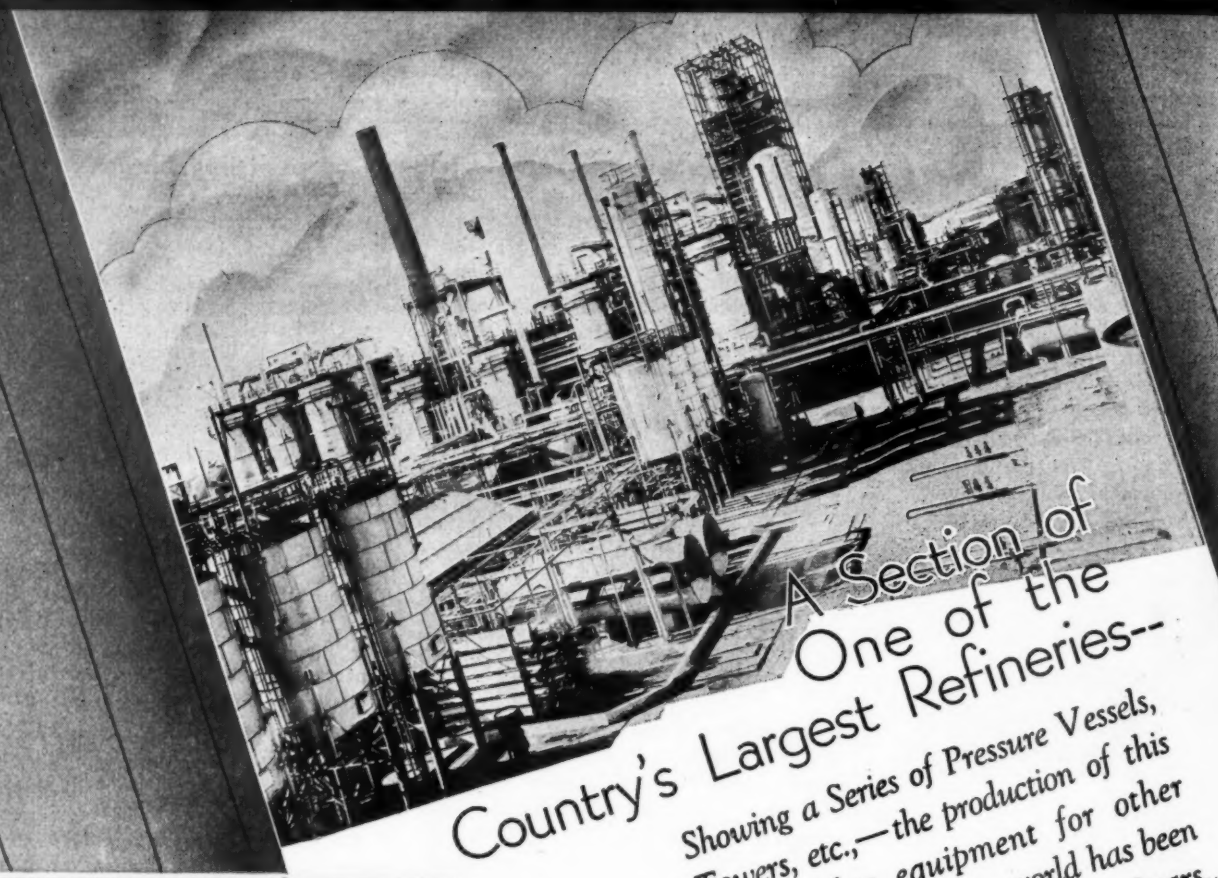
Pre-formed Foamglas insulation covers are now available for various pipe fittings in all sizes for L's, T's, unions, valves, and flange covers. Temperature range of the glass foam material ranges from —200 to 800° F. The line is supplemental to the recently announced Foamglas insulation pre-formed for piping. Pittsburgh Corning Corp.

15—Control Valves

The 4000 Series "Flo-Tested Pressure Loaded Diaphragm Control Valves" eliminate both packing boxes and springs and are said to provide almost frictionless operation with no hysteresis. Fluid pressure from the outlet side is applied to the underside of a larger area diaphragm instead of using springs; loading pressure from a remote operator or air-operated instrument is applied to the upper side of the diaphragm in the usual way. When firing boilers or stills on natural gas, the valves prevent inlet pressure variations from disturbing the controlled gas pressure. Bodies can be supplied in cast iron or cast steel. Diaphragm cases are of steel only. Trim material is Type 304 alloy as standard, with other materials optional. Diaphragms are Neoprene with fabric insertion. Valves are furnished in sizes from ½ to 12 in. Hammel-Dahl Co.



More "What's New!" Items, p. 895



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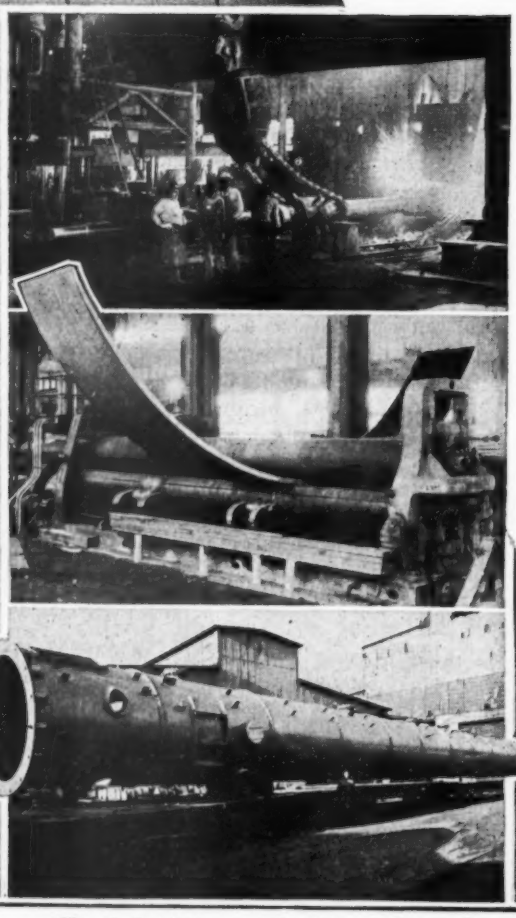
Showing a Series of Pressure Vessels, Towers, etc.,—the production of this and similar equipment for other plants throughout the world has been a part of our business for many years..



TOWERS · TANKS
PRESSURE VESSELS
PLATE WORK AND
MADE-TO-ORDER
EQUIPMENT

To Your Individual Requirements

SUN SHIPBUILDING AND DRY DOCK COMPANY

CHESTER PA. U.S.A.

Since 1916

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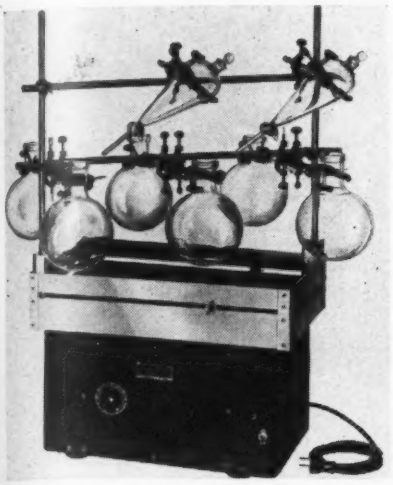
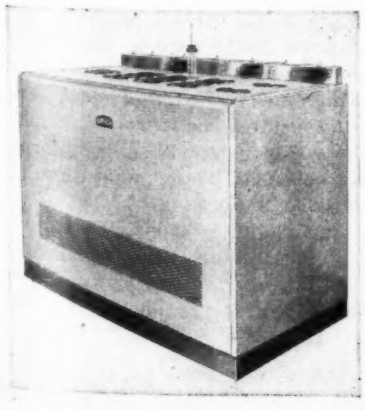
16—Laboratory Shaker



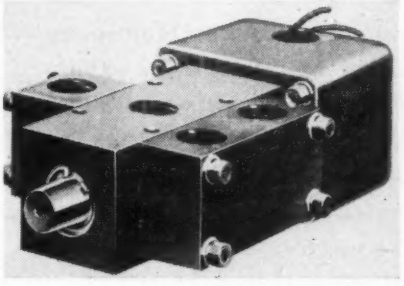
Flexibility is said to be a feature of the Eberbach Laboratory Shakers, among whose accessories is included an arrangement for handling a number of various shaped flasks and the like as shown in the illustration Units are available with different speed characteristics: single or two speeds at 160 or 280 excursions per minute or variable speed from 100 to 300 per minute, and with a line of accessories for handling different jobs in the laboratory, including one for holding a 5-gal. bottle. The anodized aluminum box carrier is 18 x 12 x 4 in. deep, and incorporates sliding bar clamps that can be located either lengthwise or crosswise in the slots in which they travel. Standard power unit is a 1/6 hp. motor, operating on 115-volt, 60 cycle, A. C. Eberbach & Son Co.

17—Cloud & Pour Tests

A new cloud and pour test unit is said to have a wider range making it useful for determination of very low pour points. It provides for two additional temperature factors, 77° and 118° F. (as outlined in the Procedure for Pour Point, 5C ASTM Spec. D97-47), and an adjustable factor from −60 to −80° F. Stainless steel tanks contain 32 copper sleeve test tube inserts with four sleeves from −60 to 80° F., eight at −30° F., eight at 0° F., eight at 30° F., two at 77° F., and two at 118° F. Temperatures are controlled by built-in thermostats. The cabinet measures 52 in. wide x 39 in. high x 27 in. deep. Current required is 110 volt, 60 cycle, single phase, A. C. Refrigeration is provided by a self-contained, two-stage, air-cooled condensing unit. Bowser, Inc.



18—Four-way Selector



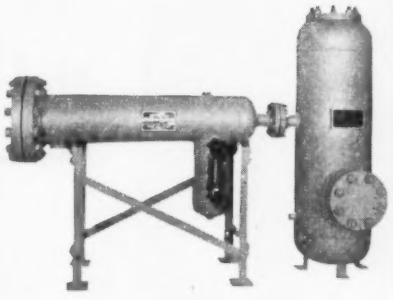
Features of the new No. 8900 series of AC solenoid-operated, 4-way selector valves include leak-proof design, one moving part, direct operation, and ease of installation, according to the manufacturer. Designed for service with water, oil, or air at operating pressures up to 250 psi., the series includes pipe sizes of 1/4, 3/8, 1/2, 3/4 and 1 in. Valves may be converted for DC operation by changing solenoids. Measuring 7-13/16 by 5-1/4 x 3-1/2 in., valve is two-position-spring-loaded in normal position. Saval, Inc.

19—Rust Preventive

Rust can be prevented in pipe lines, large storage tanks, tank cars, automobile tanks, and the like by a new additive known as RD-119, which is injected at the manufacturing point and acts from that time on to form a coating on metal surfaces with which the product containing it comes in contact. It does not affect the specification tests or performance of the products to which it is added, and will not result in higher cost to ultimate consumers, the manufacturer states. Patent applications covering the material have been filed, and license agreements to make it available for use by others will soon be obtainable. Sinclair Refining Co.

More "What's New!" Items, p. 896

PRACTICAL!
INEXPENSIVE!



Dehydration of:
Butane
Propane
and Light Oils

The same principle of two-stage dehydration works as in the case of liquid propane. By removing all appreciable free water, or condensate, in the Excel-So Separator, the dehydrating chamber has very little work to do—and may be reduced to a small size vessel —small enough to hold multiples of 1, 2, 3, 4, or 5, 100# factory packed and hermetically sealed bags of dessicant. At this small replacement cost, the material may be thrown away, at less expense than the cost of regeneration equipment.

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EXCEL-SO

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TURBO JOINTS

for EXTRA MOVEMENT at EXCESSIVE PRESSURES and EXTREME TEMPERATURES

Concentrate large expansion requirements in this *one* packless joint that *cannot* squirm or buckle.

MagniLastic Turbo Joints feature an entirely different principle in expansion joint design. Pressure is applied *externally* to a very elastic atomically-welded stainless steel bellows. This allows extra-long travel without danger of squirm or need for external reinforcement or guiding.

For the first time practically unlimited expansion and contraction in a piping system can be concentrated in a single expansion joint.

Where long piping and limited space for anchorage is encountered, Turbo Joints save on installation, eliminate anchoring of nearby points, and are maintenance free for the life of the system.

Turbo Joints are made in all pipe sizes up to 24 inches, for all pressures up to 1500 psi., and for temperatures to 1600°F.

Write for catalog T-4

MAGNILASTIC

Division of COOK ELECTRIC COMPANY, Chicago 14

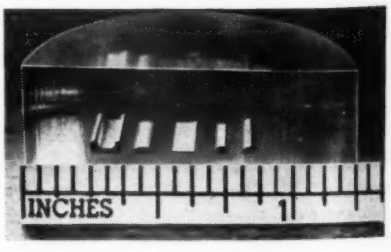
"THERE IS A MAGNILASTIC EXPANSION JOINT FOR EVERY PIPING NEED"

What's New!

20—Safe Telephone

A self-powered telephone system uses very low amount of current, making it free of electric sparks or heat and safe for use in oil refineries, volatile solvent and chemical plants, gas plants, and other applications where hazard-free communications are required, the manufacturer states. Useful where power supply is unavailable or uncertain, the unit requires no batteries or other power supply. Systems are being supplied as standard for two-station, pair-phone operation. The instruments are said to function satisfactorily in or out of doors and on installations up to 20 miles. Wheeler Insulated Wire Co., Inc.

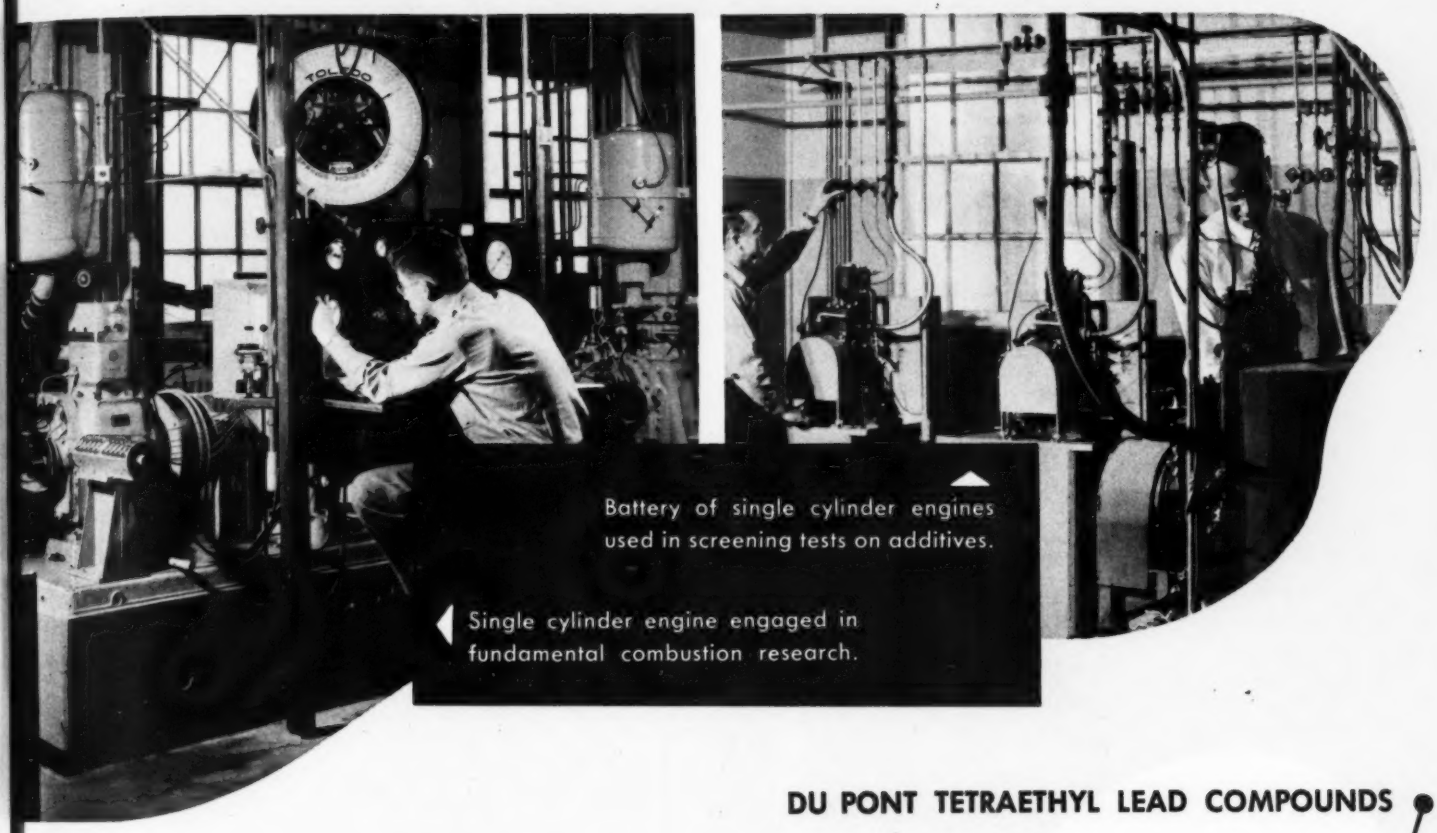
21—Instrument Material



Fine metal ribbon suitable for instrument parts among other uses is now available, being produced by rolling and drawing nickeled steel, stainless steel, copper clad steel, inconel, copper, beryllium copper, phosphor bronze, brass, and aluminum. Available shapes, up to ⅛ in. wide, include channel, square, rectangular, quarter and half round, and flat in a wide range of thickness and special shapes. Sylvania Electric Products, Inc.

More "What's New!" Items, p. 897

AT WORK . . . To Help You Solve the Fuel Problems of Tomorrow



Battery of single cylinder engines used in screening tests on additives.

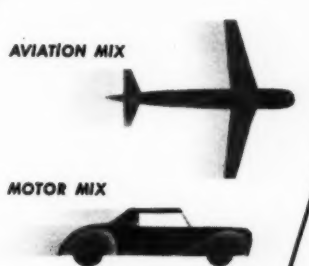
Single cylinder engine engaged in fundamental combustion research.

DU PONT TETRAETHYL LEAD COMPOUNDS

In its constant search for information, the Engineering Laboratory of the Petroleum Chemicals Division makes many tests of a routine nature. Engine tests are continually being run to determine the effect of additives on fuel performance. Full-scale road tests follow-up the laboratory tests in a final evaluation of performance characteristics.

In addition to these routine tests, the Laboratory conducts many highly specialized tests in connection with its fundamental combustion research. These often necessitate development of new testing equipment, which is another function of the Engineering Laboratory.

This is a long-range continuing program. Its goal is maximum service to the industry through improvement of present products and the development of new and better additives to meet the performance standards of tomorrow.



Gasoline Oxidation Inhibitors

Oil Soluble Colors

Lubricating Oil Additives

Fuel Oil Additives

DU PONT
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Better Things for Better Living . . . Through Chemistry

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
PETROLEUM CHEMICALS DIVISION
Wilmington 98, Delaware

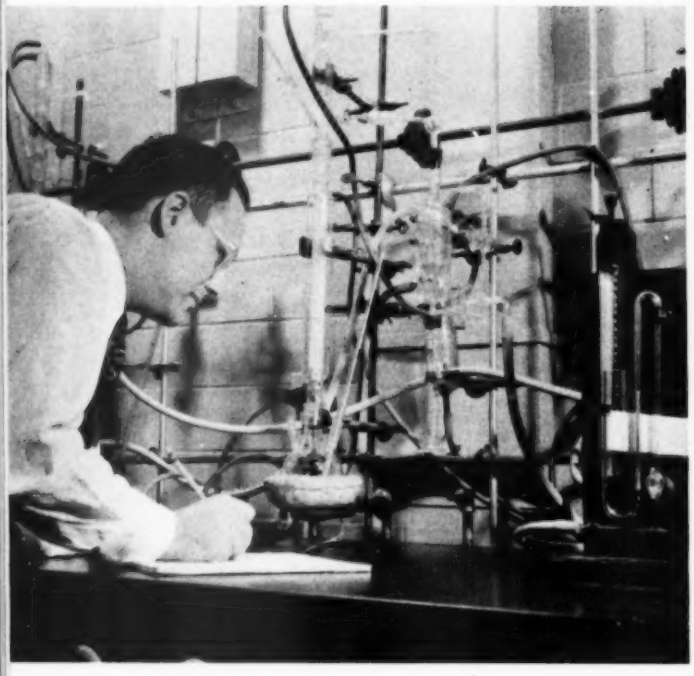
Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Tex. · El Monte, Calif.

District Offices: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Tex. · Los Angeles, Calif.

DU PONT TETRAETHYL LEAD COMPOUNDS

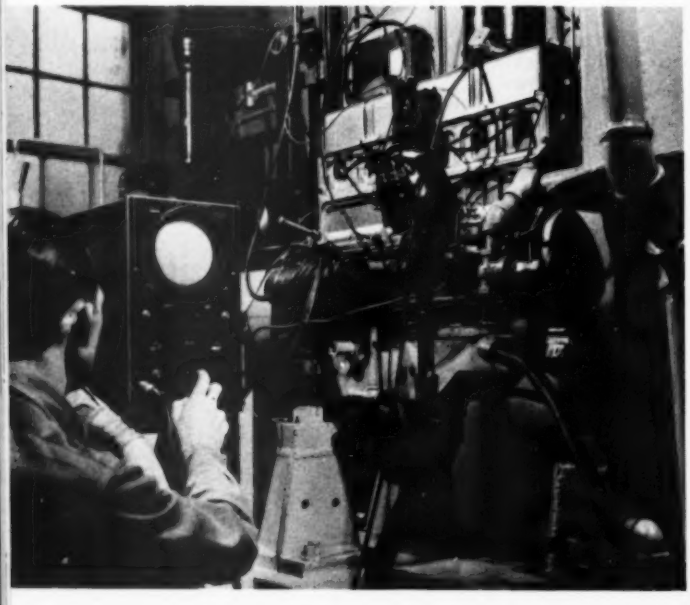
An engineering laboratory at work

...to help you produce better fuels



Laboratory apparatus used by the Jackson Laboratory in synthesizing new chemical compounds to be used as additives—an example of Company-wide research facilities available to the Engineering Laboratory.

Using cathode ray oscillograph to study fuel detonation.



Realizing the need for more intensive research in motor fuels and lubricants, Du Pont has undertaken a long-range research and development program—applying the chemical knowledge acquired over many years.

Work on fuel additives is conducted by the Engineering Laboratory of the Petroleum Chemicals Division. It is staffed with experienced personnel who are acquainted with industry problems, and its completely equipped engine laboratories are backed up with an extensive road testing fleet. With these facilities, the Engineering Laboratory is well prepared to assist in solving the many problems that loom in the future. This is positive research for the benefit of the entire industry.

As a background for the future, the Laboratory is also busily engaged in gathering basic information through fundamental combustion research. In addition, work is continually being done with other Du Pont research groups. Thus are made available for the solution of the industry's problems the benefits of all phases of chemical research—research designed to help you produce better fuels.

DU PONT

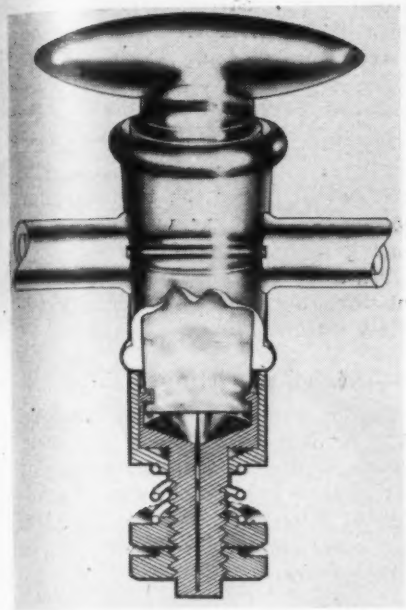
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING

...THROUGH CHEMISTRY

What's New!

22—Stopcock Adapter



Leaking of conventional stopcocks in pressure systems in the laboratory can be eliminated by the new Hamilton Stopcock Adapter, a device which fits into the groove on any standard stopcock plug to convert it for pressure work. The device consists of four major parts: a split combination screw and bushing which fits over the groove in the plug; a cup with a hole in its base which fits over the bushing; a spring which fits over the screw and presses against the cup; and a containing nut with companion lock nut to vary the pressure applied by the spring. Emil Greiner Co.

23—Refractories

Two new castable refractories for service temperatures up to 3000° F., 3X Firecrete and 3X Blazecrete, are said to air-harden quickly and can be ready for service within 24 hours after installation. The Firecrete is recommended for casting or pouring special shapes, blocks, covers, and linings; Blazecrete was developed for pneumatic application, or it can be troweled into place. Johns-Manville.

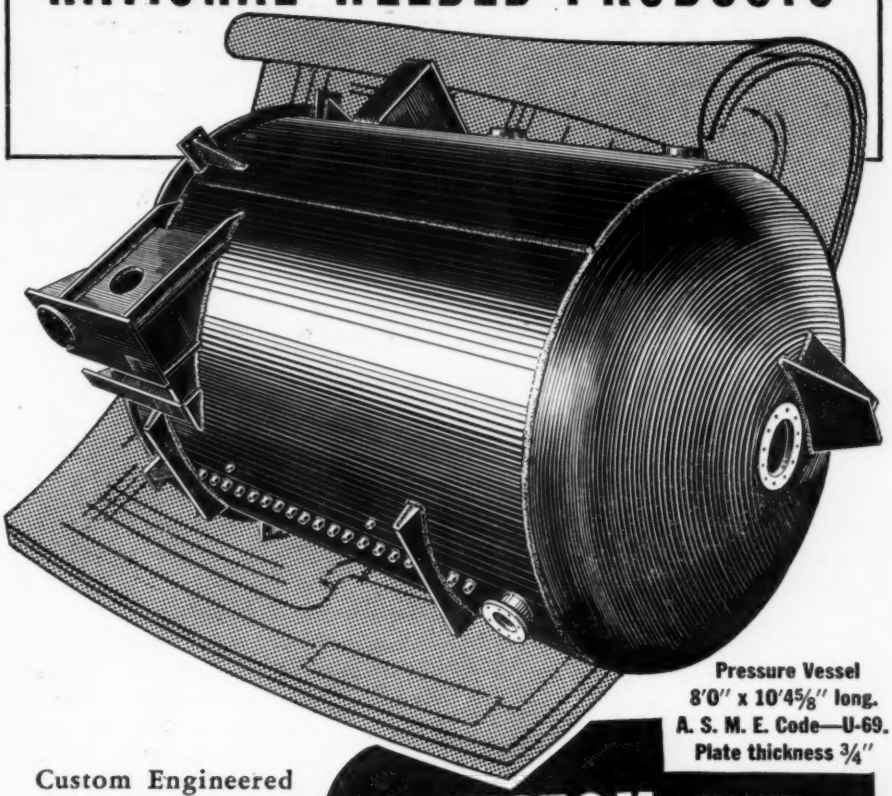
Trade Literature

24—Scientific Equipment

Apparatus & Methods, Summer Edition, 1948; the first issue of a new quarterly publication; 32 pages covering articles on the polarograph as well as a section on the latest catalog revisions. E. H. Sargent & Co.

More "What's New!" Items, p. 898

NATIONAL WELDED PRODUCTS



Pressure Vessel
8'0" x 10'4⅝" long.
A. S. M. E. Code—U-69.
Plate thickness ¾"

★ CUSTOM ENGINEERED
TO MEET EXACTING CODES AND REQUIREMENTS
FROM OPEN HEARTH, STAINLESS, STAINLESS CLAD, NICKEL, NICKEL CLAD, ALUMINUM

Custom Engineered by NATIONAL means reliable and durable equipment for the chemical, processing and petroleum industries. All manufacturing operations such as forming, welding, stress relieving and machining are performed within our own plant—under the constant protection of X-ray and manual inspections.

NATIONAL will gladly work with you while your plans are in the formative stages, or from completed blue prints.

Write for Bulletin which shows our complete fabricating facilities.

NATIONAL PRODUCTS
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Pressure Vessels
Galvanizing Kettles
Annealing Covers
Tin Pots
Salt Annealing Pots
Wire Annealing Pots
Special Plate Work

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ANNEALING BOX COMPANY
API-ASME Codes · Stress Relieving · X-ray
Pledged to Quality Since 1895
WASHINGTON, PENNA.

Practical engineers show you the dollar-saving way to increase your alloy piping efficiency in "Corrosion Resistant Piping," a comprehensive discussion prepared by the Taylor Forge engineering staff. This important new bulletin outlines the fundamentals involved in minimizing the cost of stainless materials . . . points out the advantages of conforming to IPS outside diameters . . . discusses Schedules 5S, 10S, 40S and 80S in relation to pressures and temperatures . . . and gives you a new slant on flanged connections. Write today to reserve your copy.

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Mail to Taylor Forge & Pipe Works
P. O. Box 485, Chicago 90, Ill.
715-0948

25—Catalysts

Product Information Bulletin T-1, gives data on Enjay catalysts useful in reforming, hydroforming, aromatization, hydrogenation, and like processes. Enjay Co., Inc.

26—Flow Meters

Ring Balance Mechanical Flow Meters, Series 2200-2600, Bulletin 2M48, describes this line of flow meters with explanation of the ring balance principle of operation and including diagrams and data on dimensions and capacities. Hagan Corp.

27—Insulation

Industrial Insulations, 48; is a new 24-page catalog describing a line of high temperature insulating materials in the form of plastic, block. blanket, piping coverings, and loose fibre. Forty-Eight Insulations, Inc.

28—Chemical Pumps

Milton Roy Pumps, Bulletin No. 484; describes controlled volume pumps to handle required volumes at pressures up to 20,000 psi., and features a capacity-pressure chart to aid in pump selection. Milton Roy Co.

29—Organic Synthetics

Physical Properties of Synthetic Organic Chemicals, Form 6136, a 12-page revised edition of a booklet covering applications and physical properties of more than 185 synthetic organic chemicals, presented in tabular form for easy reference. Carbide & Carbon Chemicals Corp.

30—Instrument Panels

Modern Design for Instrument Panels and Cubicles, a 12-page catalog giving dimensional drawings, and illustrations of a complete line of equipment for mounting and installing instrumentation systems, control centers, and the like. Falstrom Co.

31—Strainers

R-S Duplex Strainer, Catalog No. 37, gives detail drawings, dimensional data and specifications for a line of strainers in pipe sizes from 4 to 24 in. for supplying clean water for industrial processing and utility purposes. R-S Products Corp., Valve Division.

32—Scrubbers & Coolers

Gas Scrubbers and Coolers, Bulletin No. H-203, includes diagrammatic sections explaining multi-stage and single-stage units, along with diagrams of Peabody impingement baffle-plate action and performance. Peabody Engineering Corp.

33—Ion Exchange Resins

The Resinous Reporter, Vol. IX, No. 4, is a special issue devoted to articles describing the ion exchange method for treating water, and including a glossary of ion exchange terms as well as a bibliography of published literature. Resinous Products & Chemical Co.

34—Stainless Fittings

Taylor Forge Stainless, Bulletin 483, a four-page folder covering drawings, dimensions, and prices of new type fittings and flanges, available in Stainless Nos. 304, 347, 316, and other materials. Taylor Forge & Pipe Works.

35—Scale Removal

Chemical Cleaning in the Refinery, a four page reprint of an article by the same title, and written by C. H. Groom. Dowell, Inc.

36—Heat Exchangers

SK Heat Exchangers, Vapor Condensers, Bulletin 12-H, gives dimension drawings and data on sizes of various types of single and two pass exchangers, condensers, U-tube and tank type exchangers, Radiafin tube exchangers, and Vent condensers. Schutte & Koerting Co.

37—Small Tube Cleaner

Rotojet Junior Tube Cleaners for Small Tubes, Bulletin No. J-410, describes and illustrates a new line of tube cleaners and accessories for tubes as small as 0.495 in. I. D. Elliot Co., Roto Division.

38—Protective Coatings

Bulletin PRB-48, consists chiefly of a helpful guide suggesting types of protective coatings to use on various pieces of petroleum refining equipment, both interior and exterior. American Pipe & Construction Co., Amercoat Division.

39—Drafting Templates

Drafting Templates, a new four-page catalog on a complete line of "Time-Saver" Templates for engineers, designers, and draftsmen, including guides for ellipses, arcs, hexagonal shapes, welding symbols, instruments, electric symbols, pipe layouts, etc. Rapidesign, Inc.

More "What's New!" Items, p. 900

FOR A CLEANER CUT

in H_2S removal from liquid or gaseous hydrocarbons

. . . SHELL PHOSPHATE PROCESS

BECAUSE IT EMPLOYS an inorganic treating solution having a selective action, the Shell Phosphate Process offers unusual advantages in gas or liquid purification:

1. Hydrocarbons being treated are not contaminated with the treating solution, and harmful effects upon subsequent processing are thus avoided. *The treating agent of this process is not soluble in hydrocarbons.*

2. In the presence of much CO_2, H_2S can be removed while most of the CO_2 is left untouched.

3. Regenerated H_2S is relatively pure because of the selective removal action, and because the treating chemical has no vapor pressure and hence cannot contaminate the H_2S released in the stripper.

4. Direct-fired regenerators can be used since the *inorganic* treating chemical is thermally stable.

The Shell Phosphate Process together with experienced engineering service for its design and operation are available to any refinery under license from the Shell Development Company, Incorporated. Complete information will be supplied upon request.

SHELL

SHELL DEVELOPMENT COMPANY, INCORPORATED

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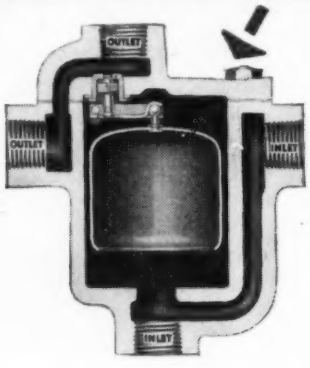
CHOOSE CLARK
All down the line

A NEW TRAP
JOINS A
FAMOUS LINE

Clark Traps

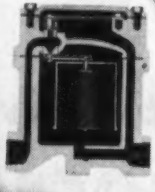
INTRODUCING THE NEW CLARK "60"



Series "80"
Inverted Bucket
Steam Trap

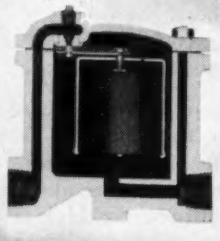
"CRV"
Pressure
Regulator

A small trap with big trap features. Positive seating with guided disc. Equipped with *two inlets* and *two outlets* for easy installation for horizontal, vertical or angle connections.



Let Clark's 40 years of experience be your guide in selecting the proper trap or valve for your drainage needs.

Series "70-T"
Inverted Bucket and
Blast Steam Trap



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Clark

TRAPS — FLOAT, INVERTED BUCKET, OPEN BUCKET AND VACUUM • REDUCING VALVES • STRAINERS

What's New!

40—Combustion Tubes

Burrell Combustion Tubes and Boats, Bulletin No. 214, gives properties and specifications on a new line of combustion tubes, trade-named ZIRCUM, and made from pure zirconium silicate, for work up to 2900° F., and with a thermal coefficient of expansion of about one-third that of pure silica. Burrell Technical Supply Co.

41—Temperature Control

Free-Vane Electronic Pyrometer Controller, Bulletin PB1237, gives principle of operations and specifications on models of an electronic instrument for low-high and proportional current-input control of temperatures up to 3600° F. in industrial furnaces, ovens, and kilns. The Bristol Co.

42—Alkylated Tar Acid

Bulletin No. C-8-114, describes properties, uses, handling, and chemical reactions of Di-tert-butyl-metacresol, an alkylated tar acid useful in rubber reclaiming and compounding, detergents and emulsifiers, resins and plasticizers, and anti-oxidants. Koppers Co., Chemical Division.

43—Electronic Instruments

Electronic Type Recording Instruments for Oxygen, Carbon Dioxide, Temperature, and Pressure; Bulletin 48-829; describes operation of an instrument for recording oxygen based on magnetic properties of the gas, other devices based on thermal conductivity of CO_2, SO_2, etc., as well as sampling systems. Hays Corp.

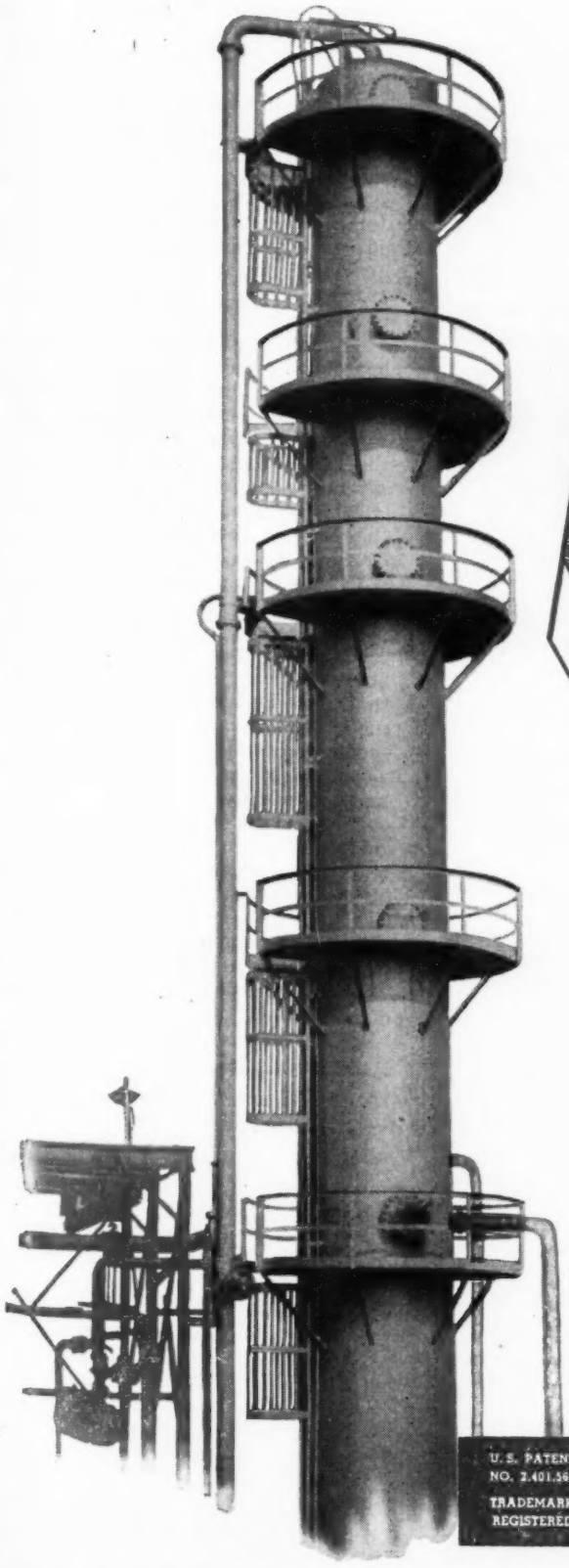
44—Flow Meters

Bailey Fluid Meters for Steam-Liquids-Gases, revised Bulletin No. 301-B; a 40-page booklet divided into ten different sections discussing flow mechanisms, primary elements, integrators, auxiliary recorders, accessories, and installations. Bailey Meter Co.

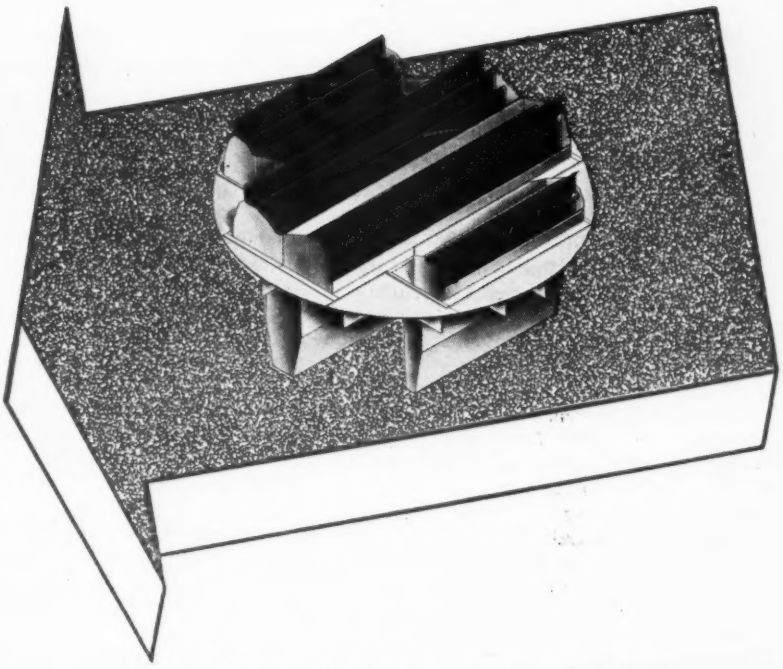
For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 889. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

THE LATEST WORD IN CRUDE OIL FRACTIONATING COLUMNS



A 6'-0" dia. Koch Kaskade crude distillation tower erected for a Michigan Refiner.



This tower has processed 10,000 barrels per day of Michigan crude, removing 75% of the crude as well-fractionated overhead and side streams. This was accomplished without overloading and without intermediate refluxing. We will be glad to advise you on your fractionating problems, no obligation.

11-13% chrome steel and Monel for lining and trays are used to minimize corrosion in this tower.

Write For Bulletin P-101

U. S. PATENT NO. 2,401,569
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Promote Cathodic Protection to Check Corrosion of Buried Structures

Eight industry associations, two nationwide communications companies and an engineering society have organized to check underground corrosion losses by means of the modern technique of cathodic protection. The annual total loss to U.S. industry due to this cause is placed at $1,000,000,000. A petroleum industry executive, H. H. Anderson, vice president and general manager of Shell Pipe Line Corp., is chairman of the inter-industry Correlating Committee on Cathodic Protection.

Recognizing that the understanding and support of management is necessary to achieve success in the program, the accompanying bulletin has been prepared by the committee to tell what cathodic protection is and how it can be applied to check the present great economic loss to industry from this form of corrosion of buried pipe and other underground structures.

CORROSION of buried plant and its contingent losses are costing American industry about $1,000,000,000 per year. Much of this loss can be stopped by proper preventive measures.

These enormous losses and the problems of preventing them are shared in different form and degree by all operators of water, gas and oil lines, communications, signal and power cables, rail tracks, tanks, equipment foundations and other metallic structures buried or in contact with the soil or water. The relative amounts of the various types of buried structures in the U. S. are shown in Table 1.

Corrosion of buried structures is simply a chemical attack by Nature which attempts to revert refined metals to their original form as ores or compounds. This chemical attack always goes hand-in-hand with a flow of electric current from the metal. In most cases a chemical attack causes the current flow but, conversely, a flow of impressed current from metal into soil causes chemical attack. If such current outflow can be prevented, corrosion cannot occur.

Regardless of whether the attack initiates the current flow or vice versa, the corrosion damage is physically similar; and a current out-flow of one ampere in one year accompanies a loss of as much as 20 lb. of iron or steel, or 70 lb. of lead.

Corrosion prevention properly starts with the design of structures and equipment, including the selection and placement of materials—in particular avoiding the contact of dissimilar metals—so as to minimize corrosion possibilities. During plant construction and subsequent operation, much corrosion can be prevented by avoiding the disposal of waste matter where it may unnecessarily pollute the soil in or near the plant. In concentrated operating areas, effective surface drainage will minimize the likelihood of soil pollution.

The attention of industry was directed, even before 1900, to the corrosion of buried pipe and cable near electrified street-railway tracks by the currents which "strayed" into these structures from the rails. The pipes and cables were corroded where these currents left them via the soil enroute back to the current source. This type of corrosion is called "electrolysis."

Joint engineering committees in many metropolitan areas, through a fine spirit of cooperation, have effectively minimized the damage to stray-current electrolysis. The customary technique is to keep the stray currents as low as possible, and to provide continuous metallic paths through which they will flow back to their source.

Though not initially recognized as beneficial, these currents, when strong enough, stopped corrosion where they strayed into the other structures because they prevented the out-flow of the weaker currents attending such corrosion. This electrical counteraction is the basis of the rapidly developing technique of Cathodic Protection.

In numerous areas where transit companies have abandoned electrified track, operators of other structures are finding that the removal of the stray railway currents has allowed the weaker currents of natural corrosion to flow unopposed. The Cathodic Protection before provided in various degrees by the stray currents has been removed!

Outside of the geographically small metropolitan areas, different problems are presented. Corrosion of buried structures is widespread unless it is prevented. Among the accepted preventive techniques are properly engineered coatings or Cathodic Protection, or a combination of the two.

If a structure could be coated with

Oil Man Heads Group

H. H. Anderson, vice president and general manager, Shell Pipe Line Corp., Houston, chairman of the inter-industry Correlating Committee on Cathodic Protection.

TABLE I—Estimated Mileages of Buried Structures in the U. S.

Type			Miles
Pipe			988,000
Gas Lines		321,000	
Natural Gas	228,500		
Manufactured Gas	71,200		
Mixed Gas	18,500		
Liquefied Petroleum Gas	2,800		
Water Lines		250,000	
Oil Lines		150,000	
Crude Oil	133,500		
Products	16,500		
Miscellaneous Oil Country Pipe		267,000*	
Steel Track			425,000
Railroads		406,500	
Transit Lines		18,500	
Metal-Sheathed Cable			167,000
Communications and Signal Systems		92,000	
Electric Power Distribution		75,000	
Total			1,580,000

* Based on a 17.5% sampling of field operations.

an impervious and durable layer of electric insulating material, all flow of current to or from the soil would be prevented. Inasmuch as the soil and moisture would be separated from the structure, corrosion could not occur.

Although excellent coatings now are available that will provide reasonable protection if carefully applied, most of them will deteriorate or become damaged in time. Such coating defects tend to focus corrosive action and hasten structure damage locally.

Early structures were buried bare, and many coatings applied on other structures prior to the last decade have little if any protective value now. To coat or recoat these operating structures—which usually requires that they be uncovered, raised and cleaned—is difficult and expensive, and often impractical.

Cathodic Protection Is Indicated

For reducing corrosion on older structures, or insuring continued protection with newer coatings, the use of Cathodic Protection is indicated. Specifically, this is the technique of impressing inward-flowing currents to counteract, and thus prevent, the outward-flowing currents of natural corrosion. Where Cathodic Protection is applicable, it has the special advantage that it can be installed with very little disturbance of the structures.

To apply Cathodic Protection requires continuous supplies of protective current. It requires also, to be buried in suitable ground-beds at appropriate distance from the structure, one or more masses of metal or carbon (called "anodes") through which this current can be introduced into the soil. For this current to serve its purpose as it fans out through the soil and distributes itself along the structure, it must be of sufficient strength or density to enter the structure and counteract the harmful corrosion currents.

Two types of protective current source may be used. Where considerable current is required, it may be obtained from direct-current generators or rectifiers connected by insulated wires positively to the anodes and negatively to the structure. For the introduction of external currents through the soil into the structure anodes of graphite rod or of scrap cast-iron or steel are customarily used.

Where less protective current will suffice, anodes can be used which will self-generate the needed current. When masses of magnesium, aluminum or zinc are buried and connected to a steel or lead structure by insulated wires, they will generate current (as in a battery) which will flow through the soil into the structure.

All types of anodes will be corroded by the protective current which they discharge to the soil, and they must be renewed at intervals. However, under favorable conditions these anodes may last several years before replacement is necessary.

Some of the current introduced at the anodes to cathodically protect one structure may enter a neighboring structure and traverse it for a distance while enroute to the protected one. Where this current leaves the neighboring structure and enters the soil, corrosion occurs which is similar to street-railway stray-current electrolysis. It can be prevented in several ways, one of the commonest of which is to connect the neighboring structure to the protected one by a wire "drainage bond" of proper resistance.

Because of this possibility of interaction, any operator planning a Cathodic Protection installation should notify operators of neighboring buried structures so that all concerned can appraise the interaction problems. Experience shows that these can be dealt with most effectively and satisfactorily through cooperative study and tests by the engineers of the operators involved.

The foregoing paragraph applies to conditions where Cathodic Protection is designed primarily for the structure (or structures) of a single operator. Frequently, however, where reasonably adjacent structures of two (or more) operators are subject to similar corrosion damage, "joint Cathodic Protection systems" can be designed, installed and operated economically.

Harmonious Cooperation Needed

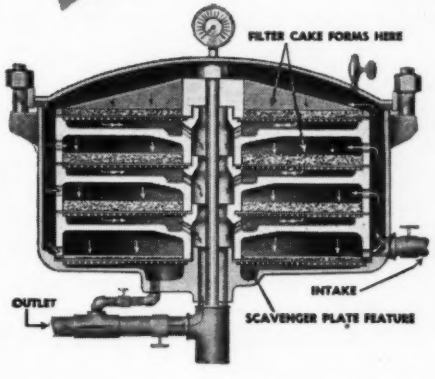
The fundamentals of Cathodic Protection are relatively simple, but solution of its technical and economic problems requires a high degree of engineering skill. The harmony in which metropolitan engineers have coordinated their complex electrolysis problems sets the pattern for the cooperation needed to deal with local Cathodic Protection problems in the field.

The use of Cathodic Protection offers widespread opportunities for reducing the enormous losses incident to underground corrosion, and its application requires cordial intercompany relations. Thus it is good business for all managers of buried plant to be generally informed about the application of Cathodic Protection, and to give sympathetic support to their engineers dealing with the problem.

Sparkler Filters

SPARKLER horizontal plate FILTERS

. . . keep petroleum products clean and free of foreign matter



The Sparkler horizontal plate method of filtration insures a firm, unbroken filter cake formed from diatomaceous earth or other filter media particularly suited to the liquid filtered. Such a filter cake removes even microscopic particles from any liquid ranging from light alcohols to heavy resin products.

The petroleum refining and processing industry have available a filter in the Sparkler that solves many problems of keeping liquid petroleum products free from solids such as scale, rust, grit, and other foreign matter.

Domestic Fuel Oil bulk plant operators can be sure of delivering clean clog-free fuel oil by filtering with Sparkler filters

Sparkler filters are available in capacities from small pilot plant models to built-in production line units of 5000 gallons per hour. The services of our staff of engineers with over a quarter of a century experience in solving filtration problems is available. Your problems will receive personal attention and individual analysis. Write Mr. W. J. Kracklauer, Sec'y & Treas.

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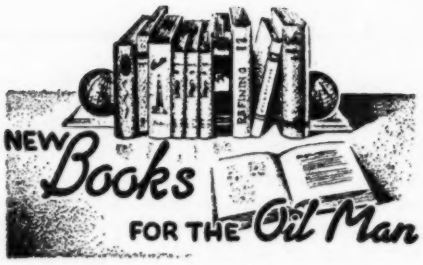


Copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third St., Cleveland 13, for the price listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax. U. S. Government publications should be ordered direct from the Superintendent of Documents, Washington, D. C.

Data on Properties Gives Value To Book on Aluminum and Alloys

Aluminum and Its Applications, by Hiram Brown and associates; 6 x 9 in., 352 pages, stiff cloth binding, illustrated, indexed, $5.75.

With the present relatively limited use of aluminum compared to ferrous metals in the petroleum and petroleum chemicals industry, it would seem that *Aluminum and its Applications* would have little interest for refinery technologists. However, aluminum as a commericial and structural material is as yet in its infancy in relationship to iron and steel. Its possibilities still present a field for exploration and development. Mr. Brown and his co-authors have compiled one of the better recent studies on this subject.

Of especial interest are two chapters dealing with the classification and properties of aluminum alloys and another describing the uses of aluminum in the chemical and related industries. The entire book is not highly technical and presents no complex formulas and diagrams. "Instead, numerous illustrations and sketches demonstrate both fabrication methods and applications," the author points out in the preface.

The chief value of the work to the refiner is probably in the provision in the appendix of considerable engineering data on the properties of aluminum and its alloys. The book has also been well indexed, a must for any general reference volume.

Author Brown is chief metallurgist of the Solar Aircraft Co., Des Moines, Iowa, a graduate in metallurgy from Fenn College, he has served as metallurgist with Aluminum Company of America, Frontier Bronze Corp., and as assistant works manager at Aluminum Industries, Inc. A number of specialists have contributed chapters in the book on applications of aluminum in such industries as chemical, aviation, automotive, electrical, and railroads.

British Fuel Ministry Issues First in BIOS Report Series

Report on the Petroleum and Synthetic Oil Industry of Germany, BIOS Overall Report No. 1; 8¼ x 13¼ in., 140 pages, heavy paper binding, illustrated. (1947).

Great Britain's Ministry of Fuel and Power has published in this booklet a thorough and critical evaluation of Germany's petroleum and synthetic oil industry. It is the first of a series of BIOS (British Intelligence Objectives Sub-committee) overall reports on German technology. The study was prepared by a mission from the British Ministry and it is based on data obtained by American and British specialists who were members of the BIOS investigating teams.

It contains technical details of processes, evaluation of machinery and apparatus, diagrams and equipment, and graphs and flow sheets. Although it is an awkward shape for handling or filing, the typography and the reproduction of pertinent illustrations is excellent. Especially helpful in the appendix is a glossary of terms and abbreviations and a set of conversion tables.

In the text itself, economic data, raw material requirements, and production figures are included. The subjects dealt with are: carbonization and gasification of coal, hydrogenation processes, Fischer-Tropsch process, crude oil production, petroleum refining, lubricating oil, and testing and evaluation of products.

Readers desiring a copy of the report should write direct to the British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. Copies are priced at $3.00 each.

Molybdenum as Alloying Element Covered in Comprehensive Book

Molybdenum: Steels, Irons, Alloys, by R. S. Archer, J. Z. Briggs, and C. M. Loeb, Jr.; 6 x 9 in., 391 pages, stiff cloth binding, illustrated, indexed.

A wide range of materials are covered in *Molybdenum*, from wrought to cast steels and from cast iron to nonferrous alloys. The major emphasis has been placed on the presentation of the fundamentals all engineers, designers, and metallurgists need for guidance in their selection of proper materials for given applications.

The authors have tried successfully to overcome a usual disadvantage of the handbook method of presentation —that of simply compiling uncorrelated data. They have shown the fields of similarity and dissimilarity of the various materials and have indicated some of the factors that may affect the choice of the most economical material for a specific piece of equipment. Considerable information is included on more recent developments. Not only are such topics as steels and alloys for gas turbines covered, but also data on the service life of some of the lower alloy steels. Among specific items of equipment discussed are many of interest to the refining industry, namely corrosion-resistant stainless steels, valves, fittings, piping, pressure vessels and plate, pumps and pump parts, tubing and tube supports, and the like.

The book was published by The Climax Molybdenum Co., and is offered free of charge to metallurgists in the petroleum processing industry upon written request to the company at 500 Fifth Avenue, New York 18, N. Y.

New Text Discusses Economic Forces of Inorganic Industry

Inorganic Process Industries, by Kenneth A. Kobe; 6 x 9¼ in., 380 pages, stiff cloth binding, illustrated, indexed, $6.00.

With increasing expansion by the petroleum refining industry into many other phases of industrial chemistry, a relatively large portion of it being in the inorganic field, *Inorganic Process Industries* is a new book which should be of considerable interest to petroleum processing engineers and chemists.

Written primarily as a college textbook, its treatment of this phase of chemistry is easily read. Nine basic types of industries are covered—natural sodium and potassium salts, sodium carbonate, electrolytic caustic-chlorine, chamber and contact sulfuric acid, nitrogen fixation and nitrogen products, and phosphorus.

Rather than being purely technical, the presentation is by the historical method with observations on the economic forces exerted by and through each particular phase of inorganic chemical processing. Author Kenneth A. Kobe is professor of chemical engineering at the University of Texas.

German Volume on Distillation And Rectification Translated

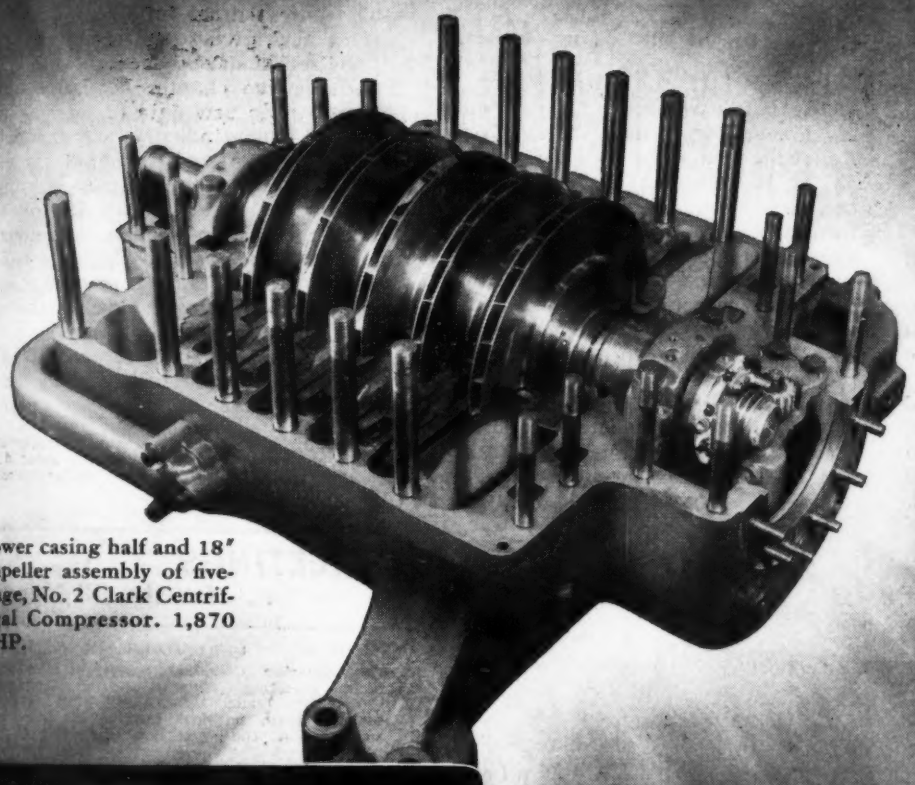
Distillation and Rectification, by Emil Kirschbaum; translated by M. Wulfinghoff; 5½ x 8½ in., 440 pages, stiff cloth binding, illustrated, indexed, $10.00.

Distillation and Rectification is the first edition in the English language of a book which has come to be regarded by many as an important aid to engineers in those industries which employ this kind of processing; for example, petroleum refining, gas liquefaction, solvent recovery, alcohol, and synthetic rubber.

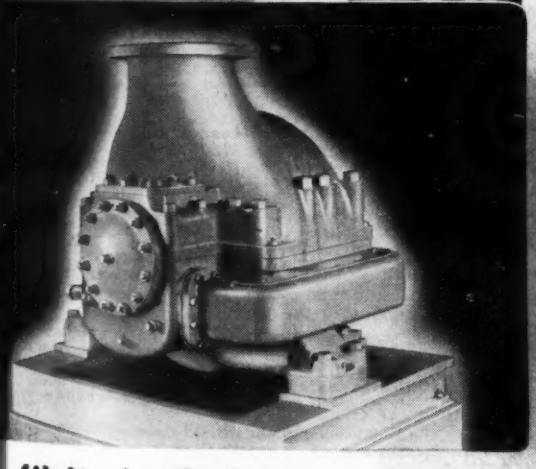
The book is a comprehensive treatment of this one type of processing and is valuable because of its thorough coverage of the equipment design involved. As far as is possible, the author has used graphical methods of presentation rather than com-

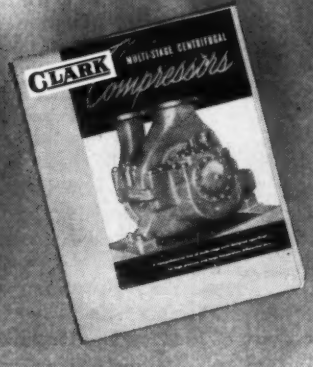
CLARK CENTRIFUGAL COMPRESSORS

for large tonnage PROPANE REFRIGERATION



Lower casing half and 18" impeller assembly of five-stage, No. 2 Clark Centrifugal Compressor. 1,870 BHP.





For the MEK Solvent Dewaxing Process in manufacturing lube oils, Clark is building seven Propane Centrifugal Refrigeration units to operate at approximately —20° Fahrenheit. Other Clark Propane Multi-Stage Centrifugal Compressors will operate at a higher temperature to cool absorber oil.

Clark's Multi-Stage Centrifugal Compressors, designed for use with Propane and other hydro-carbons as refrigerants, are particularly suitable for high pressures and large volumes. They can compress capacities from 2,000 to 120,000 c.f.m. with discharge pressures up to 475 lbs. With the Clark multi-stage design, two or more compressors can be connected in line with one driver for through drive, thus saving floor space, also installation and operating costs. They can be driven either with a directly connected turbine or a motor through a speed-increasing gear.

Clark's Multi-Stage Centrifugal Compressors can be arranged quickly and easily to meet any desired pressure or capacity within the ranges stated above. Standardized design permits use of interchangeable parts and easy adaptation to different types of service, as well as speed in filling orders Write for full information.

Write for Bulletin on Centrifugal Compressors—

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CLARK

ONE OF THE DRESSER INDUSTRIES

SETS THE PACE IN COMPRESSOR PROGRESS

plex calculations. Structural details of apparatus are considered. However, instead of specific industries, principles and suitable designs are emphasized. Of some interest is a resumé by the translator describing American practice and recent developments in technique and equipment.

The book was published by authority invested in the Alien Property Custodian of the United States Government. The author, Dr. Kirschbaum, is professor at Karlsruhe Institute of Technology: the translator, Mr. Wulfinghoff, is an engineer with Sanderson & Porter.

Fourth Volume in Series on Oil Production Is Now Available

Petroleum Production, Vol. IV, Condensate Production and Cycling, by Park J. Jones; 6 x 9 in., 244 pages, stiff cloth binding, illustrated, indexed, $5.00.

Condensate production and cycling, the subject matter of the fourth volume in Mr. Jones' series on Petroleum Production, is a topic of considerable interest today. Such products of the residue gas from condensate production as liquefied petroleum gases and natural gasoline are not considered.

The technical information presented is of primary interest to those oil men in the producing rather than those in the manufacturing phase of the business. The book deals with condensation in reservoirs, injection, production by expansion, various types of reservoirs, and maximum efficiency rate. Author Jones is a Houston consulting engineer.

Formulary Follows Same Pattern Used in Seven Earlier Editions

The Chemical Formulary, Vol. VIII, editor-in-chief, H. Bennett; 5⅜ x 8⅜ in., 474 pages, stiff cloth binding, indexed, $7.00.

Volume VIII, the latest edition of H. Bennett's well-known *The Chemical Formulary,* is now off the press. Following the same general pattern as in the previous seven editions, the book again gives many thousand formulae and recipes for mixtures and compounds in about 21 different types of business, including oils and lubricants, insecticides and fungicides, plastics, paint, adhesives, and many others. Again, as in previous editions, the book contains a large number of new data, not published previously. In addition, a number of German formulae, recently released from Allied Intelligence Groups, are included.

Tenth Fire Protection Handbook Describes Newest Developments

N.F.P.A. Handbook of Fire Protection, 10th Edition, edited by Robert S. Moulton; 5¼ x 7½ in., 1544 pages, fabrikoid binding, illustrated, indexed, $9.50.*

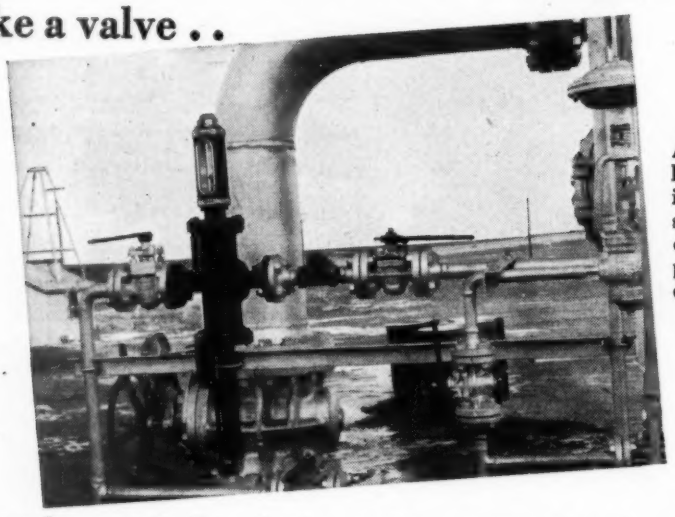
In the seven years since the 9th Edition of the *Handbook of Fire Protection* appeared, remarkable strides in fire prevention and extinguishment have been made. In this newest volume, all data that has become obsolete has been revised, and some 14 new chapters, representing about 40% more textual information, have been added, giving detailed treatment of the recent developments.

Among the chapter headings representing the new data of interest to the petroleum industry are the following: ovens and furnaces, liquefied petroleum gases, gas welding and cutting, the chemistry and physics of combustion, metals, warehousing and outside storage, building construction, protection of records, carbon dioxide extinguishing methods, and many others.

Editor Robert S. Moulton is technical secretary of the National Fire Protection Association.

* N. F. P. A. members can obtain copies at $7.00, by sending remittance with order direct to the Association at 60 Batterymarch St., Boston 10, Mass.

This flow meter "takes to" your pipe system like a valve . .



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MEETINGS . . . for the Oil Man

SEPTEMBER

6-10, Amerian Chemical Society, 114th national meeting, Midwest session Jefferson Hotel, St. Louis, Mo. (NOTE—this session of the 114th national meeting will include meetings of the Petroleum Chemistry Division.)

13-17, Third Instrument Conference and Exhibit, Convention Hall, Philadelphia.

13-17, American Assn. for the Advancement of Science, centennial meeting, Washington, D. C.

13-17, American Chemical Society, 114th national meeting, Western session, Portland, Ore.

15-17, National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

15-17, American Institute of Chemical Engineers, regional meeting, French Lick Springs, Ind.

20-22, National Butane-Propane Assn., Chicago.

27-28, Independent Petroleum Assn. of America, Plaza Hotel, San Antonio, Texas.

27-Oct. 1, National Plastics Exposition, Grand Central Palace, New York.

OCTOBER

4-9, American Gas Assn., annual convention, technical section, Ambassador Hotel, Los Angeles.

8, California Natural Gas Assn., 23rd annual fall meeting, Ambassador Hotel, Los Angeles.

11-13, National Lubricating Grease Institute, 16th annual convention, Edgewater Beach Hotel, Chicago.

12-16, National Chemical Exposition, Coliseum, Chicago.

16, American Institute of Chemical Engineers, Oklahoma annual state meeting, Tulsa.

22-23, Measurement and Control Instrument Exposition, Municipal Auditorium, Long Beach, California.

23-29, American Society for Metals, annual convention, Benjamin Franklin Hotel, Philadelphia.

25-29, National Metal Congress and Exposition, Philadelphia.

25-29, American Welding Society, annual convention, Bellevue-Stratford Hotel, Philadelphia.

26, Independent Natural Gas Assn. of America, annual meeting, Mayo Hotel, Tulsa.

PERSONALS

Petroleum Technologists in the Headlines

Stanley R. Wilson has been appointed secretary of Universal Oil Products Co. During the war he was in charge of the company's contract negotiations with the government and up to the present has been in charge of the contract department. Graduating from the University of Illinois in 1922 with a BS in industrial and mechanical engineering, he joined Universal the same year and later studied law at DePaul University, Chicago. For several years he represented Universal abroad, with headquarters in London, and was later administrative assistant in the Chicago and New York offices.

Mr. Wilson

* * *

W. C. Bryant has been promoted to chief research chemist for Swan-Finch Oil Corp., at its laboratories at Newark, N. J. For the past two years has been a group leader in the research department and previously had spent eight years in the production department as control and chief chemist.

* * *

Eugene J. Houdry will receive a 1948 Potts Medal from the Franklin Institute in consideration of his leadership in the development of the process for the catalytic cracking of petroleum that bears his name. The Howard N. Potts Medal was established in 1906 and is awarded for distinguished work in science or the arts. The presentation will be at Philadelphia Oct. 20.

Mr. Houdry

Son of a French steel manufacturer, Mr. Houdry first carried on his experiments in the catalytic cracking of petroleum in France following World War I. He came to the U. S. in 1930 and interested Socony-Vacuum Oil Co., Inc. and Sun Oil Co. in his process, which was brought to large scale commercial use in World War II under the sponsorship of the two oil companies.

Charles R. Brown has been appointed a vice president of Tide Water Associated Oil Co. He has served as assistant to the president for many years and is a member of the company's Western Division Operating Committee. He is a native of San Francisco.

* * *

Arthur V. Danner, formerly executive vice president and director of Houdry Process Corp., Philadelphia, has returned to Socony-Vacuum Oil Co., Inc., where he will be in charge of process promotion. He joined Socony-Vacuum in 1937, during the war was on loan to the Petroleum Administration for War, and joined Houdry in 1944.

* * *

E. H. Reichl is manager of the Research Department, of the Research and Development Division of Pittsburgh Consolidation Coal Co. at Library, Pa. He is a graduate of the Polytechnical Institute of Vienna, with an M.S. in chemical engineering. He has occupied positions with Babcock & Wilcox Co., Winkler-Koch Engineering Co., Standard Co., Stanolind Oil & Gas Co., and Standard Oil Co. of California. He came to Pittsburgh Consolidation Coal Co. in January, 1948, as chief process engineer of the development department.

Mr. Reichl

His work has included pilot plant development in oil technology as well as process design in synthetic gasoline derived from natural gas. During the past three years he has also conducted exhaustive investigations abroad of Germany's research and commercial operations in synthetic oil.

* * *

All directors and officers of Leonard Refineries Inc. were re-elected at recent annual meting at Alma, Mich. Officers are: **J. W. Leonard,** chairman of board; **Reid Brazell,** president and general manager; **L. R. Kamperman,** vice president and general sales manager; **John S. Pfarr,** vice president in charge of manufacturing, and **Robert L. Anthony,** secretary.

Leroy Donald, of Goodman, Miss., has joined the Lion Oil Co., El Dorado, Ark., as chief agronomist and will direct the agricultural activities of the company. He will work in cooperation with agricultural colleges, experiment stations, state extension services and state departments of vocational agriculture.

Mr. Donald

He holds B.S. and M.S. degrees from Mississippi State College, served as instructor at the University of Wisconsin and in 1929 returned to Mississippi State as associate professor in the Department of Botany. In 1936 he joined the Barrett Division of the Allied Chemical and Dye Corp. as district agriculturist, becoming its chief agronomist in 1945.

* * *

Dr. H. R. Snow, manager of Pan American Petroleum & Transport Co.'s main refinery at Texas City, has been elected a director of both Pan American Refining Corp. and Mexican Petroleum Co. of Georgia.

P. J. Sweeney, first vice president of Pan American Refining Corp., has been elected a director of Pan American Gas Co.

L. W. Moore, general manager of manufacturing, Pan American Refining Corp., has been elected a director of Pan American Pipe Line Co.

* * *

Dr. Brown

Dr. H. Trueheart Brown, assistant director of the Texas Research Foundation, Dallas, is the newly elected chairman of the Dallas - Fort Worth Section of the American Chemical Society. Previous to his appointment with the Foundation he was with the Standard Oil Co. (Indiana) and the Magnolia Petroleum Co., Dallas, working on catalytic refining processes. A native of Texas, Dr. Brown received his B.A. and Ph.D. degrees from Johns Hopkins University.

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SERVING INDUSTRY . . . WHICH SERVES MANKIND

J. H. Olehy is supervisor of technical services for Continental Oil Co., Ponca City, Okla., among recent promotions among key men in the manufacturing department. He succeeds **L. L. Davis** who was recently made manager of the company-wide development and research department.

Mr. Olehy was born in Catlin, Ill., received his early education in Colo-

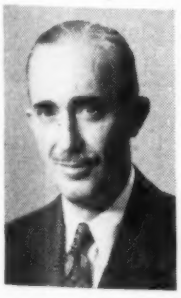
Mr. Olehy

Mr. Smith

rado and a degree in electrical engineering at the University of Colorado. He joined Continental in 1927 as assistant refinery engineer, in 1937 became process engineer and was later advanced to chief process engineer.

J. H. Smith is chief process engineer for Continental, succeeding Mr. Olehy. A native of Indiana, he received his chemical engineering degree from Purdue University. After working as process control engineer for another oil company he became a technologist with Continental Oil Co. in 1943.

B. H. Lincoln has been made patent adviser of the development and research department of Continental Oil Co. He studied at the University of Arkansas and received his chemical engineering degree at the University of Colorado, serving as an



Mr. Lincoln

Mr. Nielson

instructor as well as student at both institutions. He joined Continental in 1926 as a chemist at Florence, Col., and in 1929 was transferred to Ponca City and made research chemist. In 1930 he was made assistant to the manager of manufacturing and chief chemist in 1933.

C. A. Nielson becomes chief chemist of Continental, succeeding Mr. Lincoln. A native of Colorado he is a graduate of the University of Colorado with BS, MS and PhD degrees in chemical engineering. He went with Continental in 1937 as a senior research chemist at Ponca City, was transferred to Baltimore in 1941 as research chemist and moved back to Ponca City in 1946 to become research chemist in charge of the Process Laboratory.

Horace E. Luntz has been promoted to superintendent of the process laboratory of Continental Oil Co., succeeding Mr. Nielson. He received his BS in chemical engineering at Georgia School of Technology and his MS from the University of Michigan. He joined Continental in 1936 as refinery laboratory technician at Ponca City, in 1941 was promoted to resident chemist at the Lake Charles refinery and returned to Ponca City as technologist in 1945 after a period in the Army.

A. M. Hovlid, assistant to the manager, manufacturing department of Continental, has been appointed to

Mr. Luntz

Mr. Hovlid

the newly created position of personnel supervisor, manufacturing department, in addition to his present duties. He received his chemical engineering degree at the University of Colorado and was instructor there for a short time. His first position with Continental was at Florence, Col., and in 1928 he was appointed superintendent of the Glenrock, Wyo., refinery. He was transferred to Ponca City in 1933 as assistant to the research chemist and shortly after was made assistant to the refinery manager.

* * *

Charles B. Popkin, resident engineer at the Artesia, N. M., refinery of Continental Oil Co., has been promoted to resident engineer at the Denver refinery. A graduate in architectural engineering from Oklahoma A. & M. College, he joined Continental in 1935 as a map clerk at the Ponca City offices, advanced through various assignments and became resident engineer at Artesia in 1947.

C. G. Kirkbride, director of laboratories for Houdry Process Corp., has been elected vice president in charge of research and development. He joined the company in April, 1947, as laboratories chief, after serving as professor of chemical engineering at Texas A. & M. College. He had previously been chief of chemical engineering development for Magnolia Petroleum Co. at its Dallas laboratories; assistant director of research for Pan-American Refining Co., and earlier as chemical engineer in the Whiting laboratories of Standard Oil Co. (Indiana). He is author of the textbook "Chemical Engineering Fundamentals".

Mr. Kirkbride

* * *

Richard F. Berger is assistant manager of refineries of Wasatch Oil Co., a division of Phillips Petroleum Co. He was formerly superintendent of Inland Refineries, Inc., Spokane, a subsidiary of the Wasatch Oil Co.

* * *

Dr. O. E. Bransky, who retired recently as general manager of the Manufacturing Department of Standard Oil Co. of Indiana, is now connected with the Petroleum Division of the Economic Cooperation Administration in Washington and will probably head the oil equipment phase of the European Recovery Program.

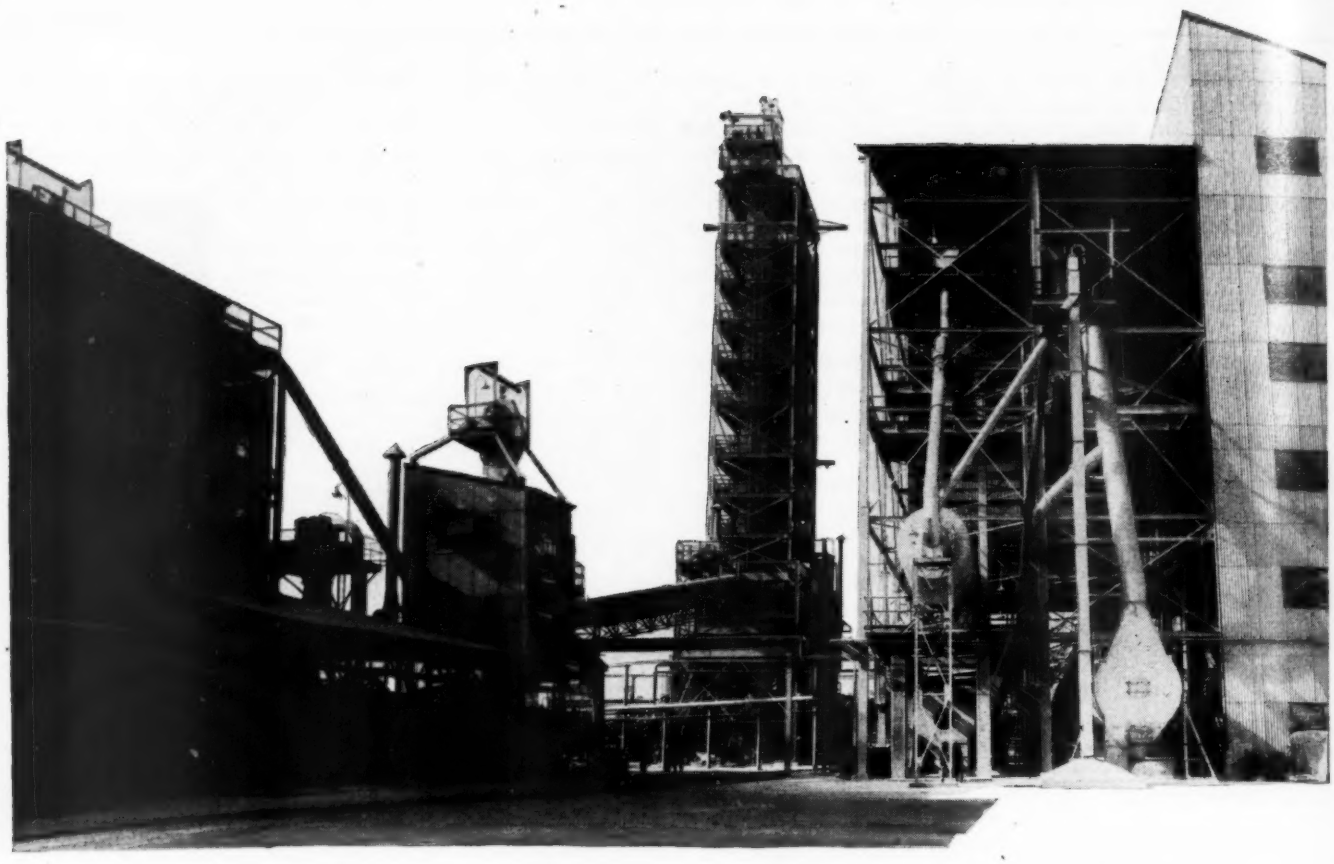
* * *

Leslie C. Beard, Jr., Assistant Director of Laboratories, Socony-Vacuum Oil Co., Inc., New York, is a new member of the Board of Directors of the American Society for Testing Materials. A native of Maryland, Dr. Beard secured his B.A. degree in 1919 from Johns Hopkins University and his Ph.D. in 1922 from the same institution and has been with Socony-Vacuum since 1923.

Mr. Beard

* * *

J. W. Leach is field engineer of the Technical Service Division of Imperial Oil, Ltd., Sarnia, Ont., Can. He was formerly with the Tropical Oil Co. at Bogota, Colombia.



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Personals

W. P. Anderson has been named general manager of refineries for California Texas Corp. in the East of Suez and Eastern Mediterranean territories. With California Standard since 1925, and Caltex since 1936, he has spent 10 years at Bahrein refinery. For the past 2 years he has been in the firm's New York offices.

* * *

Organization of a Chemical Engineering and Process Design Division has brought a number of petroleum technologists into United Engineers and Constructors, Inc., of Philadelphia.

Senior process engineers are: **Gerald L. Eaton,** formerly with Atlantic Refining Co. in research and development division and latterly in process division of the engineering and construction department of Gulf Oil Corp., **Gordon J. Robertson,** who has been in process design work with Gulf Oil Corp., M. W. Kellogg Co., Blaw-Knox Co., and Stacey-Dresser Co., and **Thomas G. Reynolds,** who has served with Standard Oil Co. (Indiana), Continental Oil Co., Foster Wheeler Co., Kellex Corp., J. F. Pritchard Co., and Pittsburgh Consolidation Coal Co.

Responsible for instrumentation is **E. A. Adler,** formerly in the same type of work with Gulf Oil Corp. and Sun Oil Co.

* * *

Mr. Crenshaw

Marvin A. Crenshaw is assistant to the vice president-director of producing and manufacturing for the California Texas Corp. A graduate of Rice Institute in 1928, he started with The Texas Co., at its Port Arthur refinery and has since continued in manufacturing and production. He came to the New York office of Caltex in 1938 and was manager of operations and planning until his new appointment.

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3. Supervision — general refinery maintenance
4. Equipment Inspectors

Applicant please supply resume of experience, photo and expected salary in initial reply.

BOX NO. 436

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Wyatt Metal & Boiler Works ..Outside Back Cover

EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

A New Impetus to the Study Of Motor Fuel Volatility

SO MUCH ATTENTION has been given to octane rating, in discussions of the properties of motor fuels, that it is important to call attention to the recently announced work of Gulf Oil Corp., in cooperation with the Ethyl Corp., in the evaluation of gasoline volatility, as described in the article on page 832.

A test procedure has been developed which promises to provide a new approach to the subject, through studies of the relationship of the distillation curve to engine warm-up performance. The method is simple enough that it can be widely used, it is adapted to road work with what are described as "reasonably satisfactory data" and it is said to give good correlation with actual "driver-feel" during the warm-up period.

The new procedure may prove of practical help to refiners through providing data on the volatility range of fuels that will give satisfactory performance in cars on the road that will aid them in shaping the distillation curve of their own motor fuels. The work to date has been largely a study of the higher boiling points as related to engine performance, to determine the possibilities for inclusion in motor fuels of the high boiling materials from catalytic cracking and polyforming, which are also high in octane number. It will be equally important to learn to what extent the lower boiling points in the distillation range can be modified, to provide for the greater use of butane and natural gasolines, if the new test procedure can be adapted to such studies.

Looking into the future, an accurate method for evaluating fuel volatility in relation to engine and operating variables may ultimately lead to the design of fuel systems more insensitive to fuel volatility, which would give refiners greater latitude in increasing the volume of their motor fuel manufacture to meet consumer demand. The economic effects to the public from such a development would be very great.

A Billion-Dollar Objective

THE OIL AND GAS COMPANIES have a very considerable stake in the inter-industry program organized to control the underground corrosion of pipelines and other structures of iron and steel by cathodic protection and other means. Data compiled in the work shows that oil and gas lines comprise almost 50% of the mileage in the U. S. of the so-called buried structures susceptible to this form of attack, which is estimated to cause an annual total loss to American industry of around $1,000,000,000.

Participating in the program are eight industry associations, including the American Petroleum Institute, two nation-wide communication systems, Bell and Western Union, and an engineering society. An oil company man is chairman of its inter-industry Correlating Committee on Cathodic Protection. He is H. H. Anderson, vice president and general manager of Shell Pipe Line Corp., who for many years has served in the joint technical work carried on by the API in oil field tubular goods and pipeline problems.

In a program of this magnitude and where cooperation among industries is required if it is to be successful, it is essential that management as well as technical personnel understand the problems involved and participate in the remedial steps. Mr. Anderson's committee has brought out a bulletin entitled "Management Information on Cathodic Protection of Buried Metallic Structures Against Corrosion", Among other data it describes in layman's language the modern technique of combatting underground corrosion by an electro-chemical action defined as cathodic protection. The bulletin is published on page 902 of this issue and it is called to the attention of executives in the petroleum refining and natural gasoline companies whose lines and tanks suffer from this form of corrosion.

Labor Board Follows FPC Tactics In Defining Interstate Commerce

A RECENT DECISION by the National Labor Relations Board in a dispute alleging violations of the Taft-Hartley Act by the Mid-Co Gasoline Co. at its Malakoff, Texas, plant parallels the thinking of the Federal Power Commission in the Interstate Natural Gas Co. case, wherein the FPC decided it had control over natural gas clear back to the wellhead, if the gas was "destined" to move in interstate commerce.

The alleged Taft-Hartley law violation bringing the NLRB into the picture is not germane to this discussion. Rather, it is the curious legal thinking which the FPC, the labor board and presumably other agencies of the federal government use to widen their field of jurisdiction over industrial concerns.

The NLRB found that Mid-Co sells and delivers approximately $300,000 worth of refined products annually to petroleum and refining companies within Texas and that these firms, in turn, sell locally. However, Mid-Co also sells a small portion of its residue gas to the Lone Star Gas Co., a public utility engaged in interstate commerce. This last type of transaction was the peg on which the NLRB assumed jurisdiction in the labor dispute.

This and other NLRB decisions along this line in the individual instance would not be important for their effect on operations in the petroleum and natural gas industries. However, they do serve to show how deeply seated and how widespread in the federal government is the doctrine of extension of authority to control the normal operations of industry. They should be taken as warnings that the need still exists for federal legislation, as was proposed in the Rizley-Moore bill, to define and limit the authority of the Federal Power Commission in the natural gas producing fields. Intrusion of authority here could easily lead to actual control by this federal agency of gas and oil producing and processing operations.

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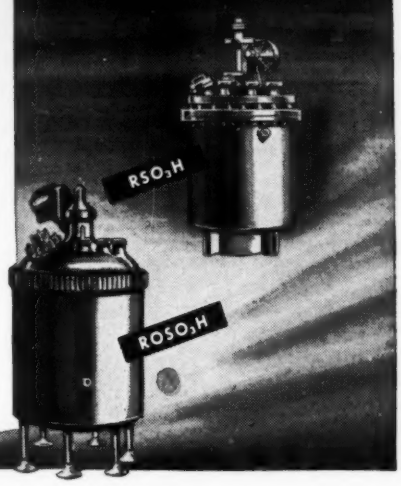

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